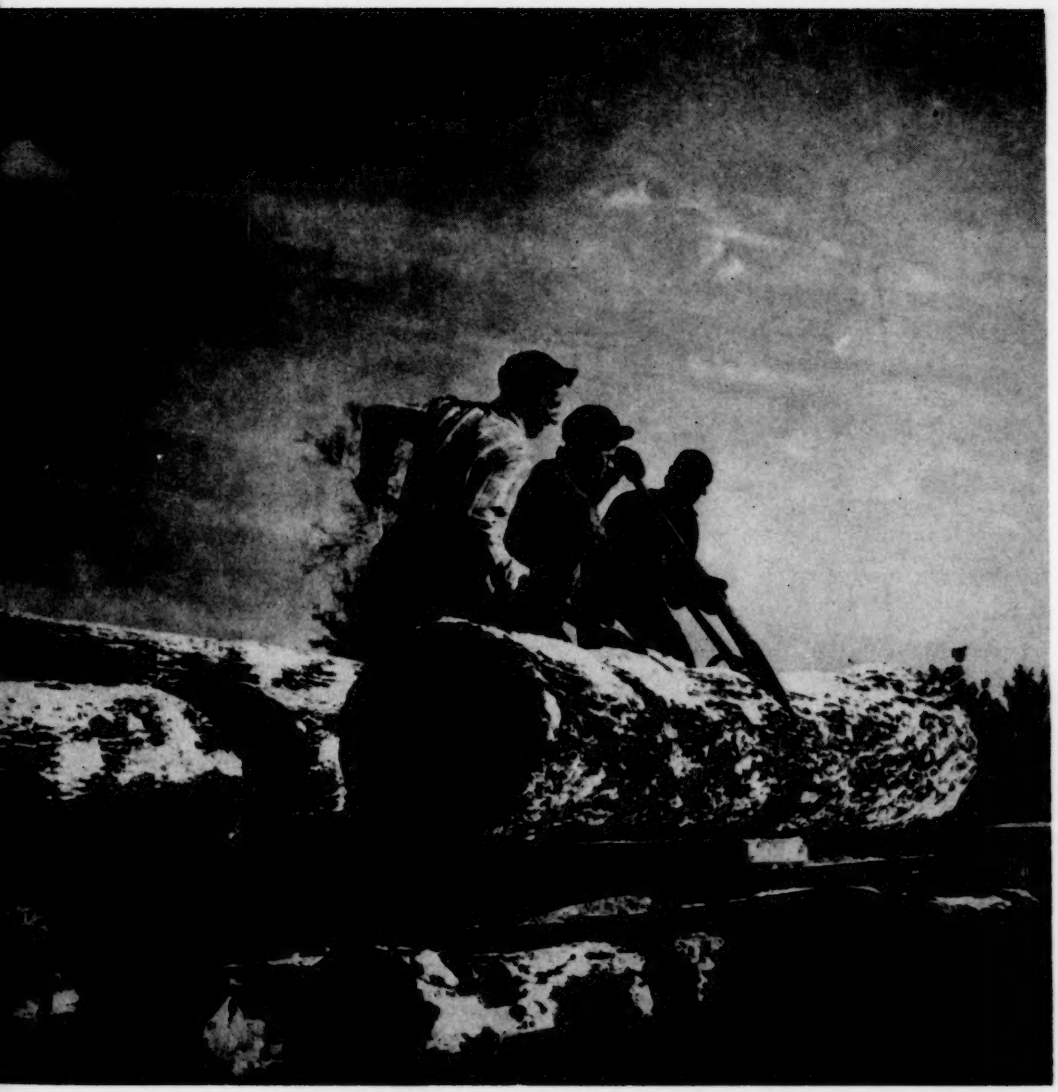

Volume 15, No. 6

November • 1960

Subsoiling Seldom Pays

Ontario's Conservation Authorities

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Spring Development

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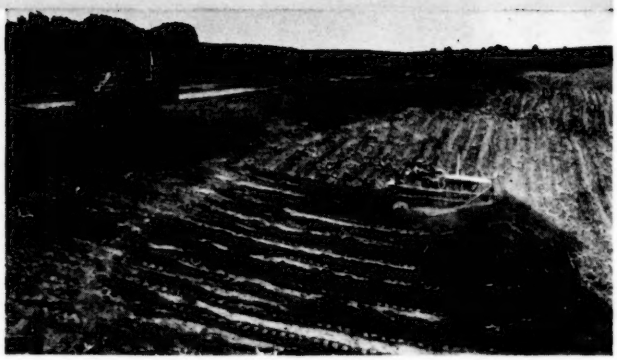

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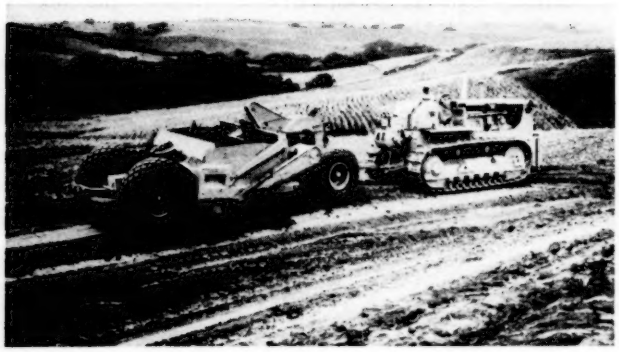

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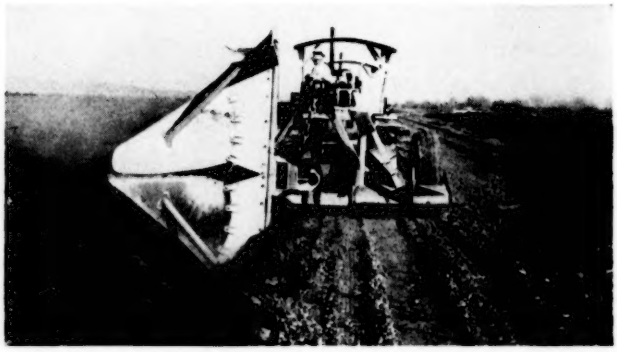

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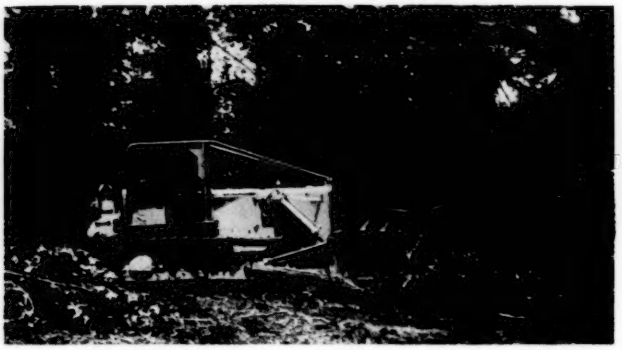

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VOLUME 15
NUMBER 6

JOURNAL OF SOIL AND WATER CONSERVATION

Reg. U. S. Pat. Off.

TO ADVANCE THE SCIENCE AND ART OF GOOD LAND USE

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Workers using peavies roll a large log on the log deck in White Mountain National Forest, New Hampshire.

United States Forest Service Photo

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The Society in Action!

During the press of a seemingly endless day have you ever entertained visions of a peaceful, pleasant afternoon to be spent relaxing along the banks of that clear stream meandering carelessly through the community where you lived as a youth?—remember those hours of fishing with the family—those hours of fun in the "old swimmin' hole" —those solitary "thinking hours" you spent "just angling"?

Have you returned to that community recently? Were you shocked as you drove along that well-known creek or river? Such visits often offer little consolation to the individual interested in the proper care of our renewable natural resources. Most of the old swimming holes have long been heavily silted and are not inviting to the youth of today or the "oldster" nostalgically recalling the past. One would wait for many a day for even a single fish to take his hook—then it would be a scavenger—at the family fishing center of yesterday.

All members of SCSA are well aware of these conditions, caused by siltation of creeks and rivers draining our productive lands. They know too of the pollution of our waterways, endangering the health of man and animal alike, by over use of them as a waste disposal system.

Most Society members have given more emphasis to siltation than to the factors affecting our streams through heavy discharge of municipal and industrial wastes. But the pollution aspect and the quality of water is also of great concern to our members, as it is to all citizens, for it relates to our health, our enjoyment of water for recreational pursuits, and to the agricultural, industrial and economic development of any given area.

A number of Society members will want to attend and all will follow with interest the developments at the National Conference on Water Pollution to be held in Washington, D. C., December 12, 13 and 14.

Last year President Eisenhower vetoed the bill passed by Congress known as Blatnik Bill (H. R. 3610). Upon vetoing this bill the President asked Arthur S. Flemming, Secretary of Health, Education and Welfare, to call a national conference on the pollution problem for the purpose of studying approaches to it.

Most conservation groups had supported the Blatnik Bill, designed to expand Federal assistance for pollution control, and these groups were disappointed when it failed to become law. In the President's veto message reference was made to pollution as a "uniquely local problem." This puzzled those who believe that all levels of government and all citizens have a real stake in the quantity and quality of this Nation's water supply.

It now seems that the President wanted to focus public opinion on the problem. Secretary Flemming invited representatives of 35 national organizations to serve on a steering committee for the forthcoming conference. Your Society has been represented at the two meetings of this committee.

Following the first meeting of the committee in June, confusion and/or disagreement concerning the purpose of the conference was much in evidence. It was not until Secretary Flemming appeared before the second meeting of the committee in August and forcefully resolved the issue, at least for the present, that final plans were formulated.

The Secretary stated the conference must strive for substantial agreement on two basic issues: (1) national goals for water pollution control, and (2) specific programs needed to reach these goals. He added that positive action will come only if the causes of controversy over pollution abatement and the goals and methods of obtaining ample, quality water supplies are discussed freely and openly. In this conference he saw such an opportunity.

It is hoped that this proposed new and democratic attempt to improve water pollution control will lead to progress. Possibility for success could have been enhanced through more concern for agricultural and forestry interests, public and private; but the theme is of concern to all citizens and may well be a new "first step": "Clean Water—A Challenge to the Nation."

Another meeting of interest to SCSA members is the scheduled Symposium of Section O (Agriculture) of the American Association for Advancement of Science to be held in New York City at the Roosevelt Hotel, December 27-30, 1960.

Dr. Firman E. Bear, past president of the Society and a member of the Council for many years, is serving as chairman of the committee planning the symposium. Several Society members are scheduled to present papers.

Theme for the meeting is "Land Zoning in Relation to Agriculture, Suburban, Industrial, Forest, and Recreational Needs of the Future." A total of 25 participants will take part in the symposiums of Section O. Separate half-day sessions are scheduled on the subjects: "Rural Land Zoning"; "Suburban Planning"; "Community Planning"; "Forest and Recreational Planning"; "Government as Land Owner and Redistributor."

Complete information may be secured by writing to the American Association For Advancement of Science, 1515 Massachusetts Ave., Washington 5, D. C.

—H. Wayne Pritchard
Executive Secretary

Subsoiling Seldom Pays in the Midwest

V. C. JAMISON, W. E. LARSON AND W. G. LOVELY

Research has shown few benefits from either deep tillage or deep fertilizer placement in the Midwest. These practices sometimes increase yields, but costs increase greatly with the depth of soil treatment. The true value of any yield increase must be considered in relation to costs necessary for obtaining the increase.

The research data available lead to this general conclusion for the North-central States: *It is doubtful if expensive subsurface soil treatments will give economic returns for corn, alfalfa or other forage crops where good fertility and management practices are used on the normal surface plow layer.*

DESPITE THE EVIDENCE of completed research, interest in deep tillage methods comes and goes. A favorable report from some locality stimulates new interest and additional testing over a wide area. When the results from this testing show little or no advantage over normal tillage methods, interest subsides.

Then, another report of favorable results under certain soil and weather conditions revives interest and sets off a new series of tests. The glamour of new equipment or a novel way of placing fertilizer in the subsoil may catch the fancy of farm operators and researchers alike, and again the cry—more testing.

This recurring cycle of interest and testing may be due in part to short memories or because the research data available has not been reviewed, summarized, and published as one unit. This article attempts to fulfill the latter need.

Deep Tillage

The conditions favoring tillage below the normal plow depth of 6-8 inches are limited to certain soil, cropping, and often specific weather conditions (5, 9, 10). Very compact layers tend to develop, for example, under machinery traffic on some of the medium-textured soils in the delta land of Mississippi and Louisiana. When this "pressure pan" is broken by deep tillage in the fall, moisture storage from winter rainfall may be improved, and yields of the following crop may be increased. The effects of deep tillage are usually temporary. These expensive treatments must be repeated often, and soil moisture content as well as weather conditions must be favorable if the treatment is to be effective.

Where soils freeze regularly to considerable depth or where droughts may cause shrinkage and subsoil cracking as in the North-central States, research has shown few benefits from deep tillage (2, 3, 4, 6, 7). These natural forces may change the subsoil structure more than is possible by deep tillage with a chisel drawn through the subsoil layers at a great expenditure of power (8, 11). In a review of the research on deep tillage in the Great Plains States, Duley found no evidence of general benefits from subsoiling (1).

Lovely

Jamison

Larson

Dr. Vernon Jamison is a soil scientist headquartered at the University of Missouri, Columbia. Dr. W. E. Larson, soil scientist, and Mr. W. G. Lovely, agricultural engineer, are located at the Iowa State University, Ames.

These three men are all associated with the Agricultural Research Service, United States Department of Agriculture.

Subsoil Fertilization

Research on subsoil tillage alone or in combination with deep lime or fertilization experiments has been conducted in Iowa, Illinois, and Missouri. The results indicate expensive subsoil fertilization generally cannot be justified if good fertility and management practices are used for the surface plow layer.

Results from experiments at McCredie, Missouri, indicated possibilities for increasing the depth of the fertile root zone in one particular soil. Woodruff and Smith found that mixing lime into the plowsole layer of a Mexico silt loam soil (claypan soil with an acid B horizon) improved the growth and rooting depth of sweetclover (12). Shattering the plowsole layer without the addition of lime, however, proved detrimental to crop growth. This is probably because some of the acid subsoil was mixed with the topsoil.

Plowsole tillage and deep fertilization tests were conducted in Missouri from 1948 through 1958. Subsoiling and deep fertilization experiments were started in Iowa in 1955 and continued through 1958. Subsoiling tests in Illinois were conducted from 1954 through 1956. Some deep lime and fertilizer experiments were started in 1955 on a claypan soil at Carbondale, Illinois.

Results of the Missouri and Iowa subsoiling and deep fertilizer treatments and the Illinois subsoiling experi-

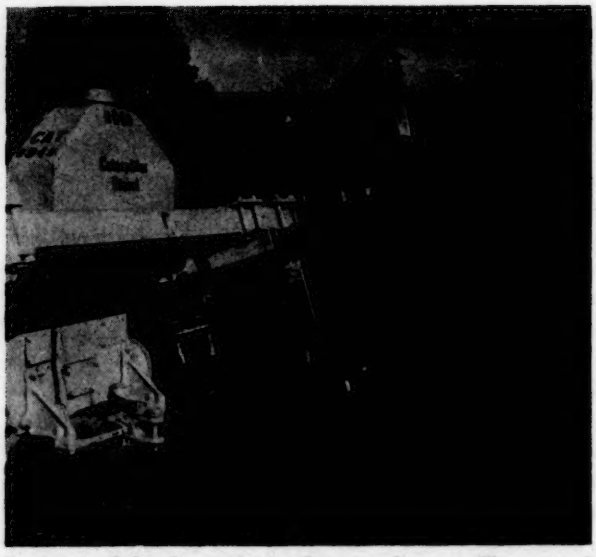

Figure 1. Subsoiler with fertilizer applicator. The ground wheel was used to drive the metering device, and the rear shank led the fertilizer to the bottom of the subsoiled channel.

ments as well as the preliminary results of the Carbondale experiment have already been published (3, 6, 7). The remainder of this article is a review of these tests and an examination of their significance.

Iowa Research Results

Iowa study sites were chosen where considerable local interest existed and on soil types of major importance exhibiting wide contrasts in soil properties. The treatments compared different depths of tillage, with and without applications of fertilizer in the tilled zone. The tillage treatments tested were a check treatment at normal plow depth and subsoiling to 16 and 24 inches. On one soil, Ida silt loam, the subsoiler penetrated to only 20, rather than the planned 24, inches.

The subsoiling and deep fertilization was done with the equipment shown in figure 1. Fields were subsoiled at 40-inch intervals, and corn rows were planted directly over the subsoiled channels. All subsoiling was done in the fall except on the Ida silt loam which was subsoiled in early spring.

The soils included in the study were Ida, Marshall, Galva, Edina, and Grundy silt loams and Webster-Glencoe silty clay loam. These soils represent the Brunizem, Humic-Gley, Regosol, and Planosol Great Soil Groups.

Subsoiling alone resulted in no significant changes in corn production in most cases. Table 1 shows the effect of subsoiling 16 and 24 inches deep at various locations in Iowa. Subsoiling at 24 inches decreased the corn yield on Edina silt loam by 9.7 bushels per acre in 1956 and 6.4 bushels per acre on Grundy silt loam in 1957.

While there was considerable local interest in Iowa, past research indicated that few benefits should have been expected from subsoiling on the soils studied. There were no severely compacted layers in the root zone within reach of subsoiling tools.

Effect of fertilizer placement in the subsoiler slots on crop yields on the Ida and Webster-Glencoe soils is summarized in table 2. The amounts of N, P_2O_5 and K_2O applied per acre were 80-80-0 for the Ida and 0-120-0 for the Webster-Glencoe soil. Fertilizer was distributed in a band in the bottom of the slot on Ida and in a zone extending upwards 4 inches from the bottom of the slot on the Webster-Glencoe soil.

Note that when the fertilizer was plowed down, yields were better than with deep placement. The lower yields for the 16-inch placement as compared to plow layer placement on the Webster-Glencoe soil were still noticeable 3 years after application.

Illinois Research Results

Subsoiling trials were made on Ashkum, Drummer, Elliott, Martinton, and Symerton soils at eight locations in Will and Kankakee counties. These soils are representative of the Brunizem and Humic-Gley Great Soil

TABLE 1

Effect of Subsoiling 16 and 24 Inches Deep on the Corn Yield at Various Locations in Iowa

Location number	*Time of subsoiling*	*Year corn grown*	*Soil type*	*Subsoiling depth*		
				None	*16 inches*	*24 inches*
				Bushels per Acre		
1	April '55	'55	Ida silt loam	31.4	—	[1]30.4
2	Oct. '55	'56	Marshall silt loam	52.2	49.6	49.8
3	Oct. '55	'56	Galva silt loam	98.8	96.0	84.6
4	Oct. '55	'56	Webster-Glencoe silty clay loam	60.8	61.4	62.2
5	Nov. '55	'56	Edina silt loam	68.4	64.4	[2]58.7
6	Oct. '55	'56	Grundy silt loam	78.0	78.0	74.6
7	Nov. '56	'57	Galva silt loam	97.8	96.4	—
2	Oct. '55 and '56	'57	Marshall silt loam	99.4	103.5	97.8
6	Oct. '55 and '56	'57	Grundy silt loam	104.3	103.3	[3]97.9
5	Oct. '55	'57	Edina silt loam	59.3	56.3	55.2
4	Oct. '55	'57	Webster-Glencoe silty clay loam	73.4	71.0	75.6

[1] The subsoiler penetrated to only 20 inches. [2] Yield decrease over no subsoiling treatment significant at 1 percent level.
[3] Yield decrease over no subsoiling treatment significant at 5 percent level.

TABLE 2
The Effect of Plowed-under and Deep-placed Fertilizer on Corn and Oat Yields in Iowa

Soil type	Time of application	Year crop grown	Crop	Fertilizer placement[1]			
				No Fertilizer	Plowed under	16 inches deep	24 inches deep
				Bushels per Acre			
Ida silt loam	April 1955	1955	Corn	21.0	39.8	—	[2]37.6
Webster-Glencoe silty clay loam	Oct. 1955	1956	Corn	54.4	68.5	[3]58.5	64.5
Webster-Glencoe silty clay loam	Oct. 1955	1957	Corn	62.0	82.9	[4]70.0	79.8
Webster-Glencoe silty clay loam	Oct. 1955	1958	Oats	50.0	73.9	[4]61.7	69.5

[1] The deep-placed fertilizer on the Ida silt loam was applied in the bottom of a subsoiled slot. For the Webster-Glencoe soil it was distributed from the bottom to 4 inches above the bottom of the subsoiled slot. In both experiments the fertilizer was banded at 40-inch intervals immediately below where the corn rows were placed. The fertilizer placed at the various positions on the Ida soil was 80–80–0 and on Webster soil was 0–120–0. In all cases the comparison between fertilizer and no fertilizer was significant at the .05 or .10 level of probability. [2] The subsoiler and fertilizer penetrated only to 20 inch depth. [3] Significantly lower at .05 probability level than for phosphate plowed under. [4] Significantly lower at .10 probability level than for phosphate plowed under.

TABLE 3
Effect of Subsoiling 12 and 18 Inches Deep in the Fall of 1955 on Corn Yields in 1956 and 1957 at Various Locations in Will and Kankakee Counties in Illinois

Location number	Soil type	Depth subsoiled			Depth subsoiled		
		none	12 inches	18 inches	None	12 inches	18 inches
		1956—Bushels per Acre			1957—Bushels per Acre		
1	Ashkum silty clay loam	79.3	76.7	83.5	109.7	102.0	99.2
2	Drummer silty clay loam	70.7	74.3	74.4	62.9	66.8	[1]84.3
3	Drummer silty clay loam	83.0	84.4	79.7	100.1	99.3	97.3
4	Drummer silty clay loam	67.9	78.6	75.3	—	—	—
5	Elliott silt loam	75.6	77.5	90.2	92.5	85.1	95.8
6	Elliott silt loam	50.1	53.2	58.4	71.0	74.2	67.0
7	Martinton silt loam	76.3	74.3	76.7	—	—	—
8	Symerton silt loam	96.3	96.2	[1]102.1	77.1	75.2	80.6

[1] Yield increase over no subsoiling treatment significant at .05 probability level.

Groups. Sub-soiling 10-12 and 16-18 inches deep was compared with ordinary plowing. An implement similar to that shown in figure 1 was used at 40-inch intervals. Subsoiling was done in September 1954, when the soils were relatively dry.

The subsoiling operations on the Ashkum and Drummer soils were perpendicular to the row directions; on the other soils it was done across the slope and generally parallel to the rows. The areas were first- or second-year legume seedings and were fall plowed, usually several weeks after subsoiling. Previous rotations generally had been 2 or 3 years of corn or soybeans, followed by oats and 1 year of alfalfa. Lime and phosphate had been applied to the fields on the basis of needs indicated by soil tests.

Th effect of subsoiling on corn yields in the first and second years after treatment of these soils is shown in table 3. Among the eight test areas in 1956, statistical analysis indicates that only on the Symerton soil subsoiled at 18 inches is there a good probability that the increased yield was due to subsoiling and not to other chance differences in the test plots. Six of the experiments were continued during the second year. Only the 18-inch treatment on one Drummer soil gave a substantial increased yield that was statistically significant, the other Drummer soil studied showed a small yield decrease in the second year.

These tests indicated that even for the same soil type, benefits from subsoiling can be expected only part of the time and at few locations. Benefits probably will occur where there are severely compacted soil layers in the root zone within reach of the subsoiler.

The experiments started at Carbondale in 1955 are on Weir silt loam, a claypan soil. Phosphate and potash

Figure 2. A cross section of an area subsoiled on a 42-inch spacing at a depth of 24 inches. About one-half the subsoil between normal depth of plowing and the depth of subsoiling was disturbed by the subsoiling operation.

fertilizer were mixed with the soil at 1, 2, 3, and 4 times the total requirements indicated by soil tests for the upper 3 feet of soil. This mixing of fertilizer and soil was done to depths of 9, 18, 27, and 36 inches. The 9-inch depth mixing was done by plowing and disking, while a disk plow was used for this purpose to the 18-inch depth. At depths greater than 18 inches the soil was removed to the 27- or 36-inch depth, mixed with lime and fertilizer by using road grading equipment and then replaced on the test plots.

Preliminary results reported for 1956 showed that even though corn rooting was influenced markedly, yields were not affected by depth to which lime and fertilizer were mixed with the soil (3). *Lime and fertilizer increased yields and mixing the fertilizer in the topsoil was as effective as mixing it in the subsoil layers.*

Higher rates of fertilization above minimum requirements did not give significant yield increases. Higher rates of fertilizer application in the surface soil layer tended to decrease yields. It still is too early for a report of any residual effects of these treatments to be available.

▸ *Missouri Research Results*

Subsoiling alone appeared to be detrimental to yields in these studies conducted on the claypan Mexico silt loam at McCredie from 1941 to 1953. This is probably because subsoil tillage unavoidably mixes some of the acid subsoil with the more fertile topsoil. Only when lime and phosphate fertilizer were mixed with the subsoil or placed in subsoil slots was there any evidence of benefit (6, 12). The lime and phosphate were applied in furrow bottoms and mixed into 7 inches of the subsoil by shattering the layer with a road plow or a lister point before the topsoil was again turned into each furrow. This method improved the rooting and growth of sweetclover and resulted in a small increase in corn and soybean yields, but it did not increase the yields of small grains.

These plots, originally treated in 1941 and retreated in 1947, were seeded to alfalfa in 1955 to study the residual effects on hay yields from subsoil shattering and deep placement of lime and fertilizer. For 10 cuttings during the following 3 years, the average increase per cutting was 0.09 tons per acre on the treated plots. Though small, the increase was consistent enough to be significant and to indicate that deep treatment of acid subsoils may benefit deep-rooting legumes.

Beef production and the carrying capacity of a brome-ladino pasture treated by shattering the subsoil with a lister point, then mixing lime and fertilizer with the soil to a depth of about 15 inches, were not significantly better than that of a surface-fertilized bluegrass pasture. Runoff, likewise, was not significantly different.

The plowsole method of treatment on terraced areas gave an apparent average yield increase per acre of 4.0 bushels of corn for 7 crop years and 2.45 bushels of soybeans for 2 crop years, but the increases were not statistically significant. There was a small, but not significant, decrease in average runoff (0.28 inches per year) on the treated plots. Runoff decreased during each period that a sweetclover cover crop was growing. Thus, the small average decrease in runoff can be attributed to drying of the soil to greater depths by deeper rooting of the clover in the treated areas. The drier soil absorbed more rainfall, thus reducing runoff.

Four methods of placing or mixing lime alone and lime plus concentrated super-phosphate were tested in 1954. Lime was applied at the rate of 8 tons per acre alone or in combination with 400 pounds of 45-percent phosphate. Corn was grown on one set of plots, alfalfa on another. With each of the crops, each of the four methods of treatment was replicated four times for comparison with untreated check plots.

The treatments were lime or lime and phosphate (a) applied to the plowsole, (b) placed in subsoil slots to a 20-inch depth at 21-inch intervals, (c) placed in subsoil slots to a 30-inch depth at 42-inch intervals, and (d) mixed into the subsoil by a double plowing method. (The last method consisted of mixing about one-fourth of the lime or lime and phosphate into the surface and plowing 12 inches deep. The rest of the lime or lime and phosphate was mixed into the exposed subsoil. Then the subsoil was inverted into place by another 12-inch plowing.)

The results of these treatments in terms of corn yields are summarized in table 4. Placement of lime on the plowsole showed little benefit to corn. Small but significant average increases resulted from lime placement in the subsoil slots and from the double plowing method. The concentrated superphosphate had little effect or tended to decrease yields when placed with the lime.

Though statistically significant, the corn yield increases from deep placement of lime or lime and phosphate are too small to be of practical value. The average annual corn yield increases resulting from deep placement in subsoil slots from 1955 through 1958 were 7.8, –0.8, 1.6, and 1.9 bushels per acre. The treatment was most effective for the first crop after treatment.

Effects of the treatments on alfalfa yields are shown in table 5. Lime alone placed in the subsoil by these methods was of little benefit for alfalfa. In connection with superphosphate, placement in the more closely spaced slots gave a small hay yield increase.

Reasons for the difference in the response of corn and alfalfa to these methods of subsoil applications of lime

or lime and phosphate must lie in chemical reactions among soil, phosphate, and lime, and in differences in the nature of corn and alfalfa roots. Examination of the soil in observation trenches across the plots in the fall of 1958 showed no evidence of alfalfa root concentrations on the plowsole or in the slots, but there was some concentration of corn roots in the treated zones containing considerable unreacted lime.

Conclusions

The results of these and other studies indicate that the benefits, when they occur, from deep tillage and deep fertilization are both variable and relatively small in the Midwest. Considering the expense it is doubtful if subsoiling treatments can be justified in the North-central States—particularly as compared with the use of good fertility and management practices in the usual plow layer.

TABLE 4
Comparison of Lime and Phosphate Deep Placement Methods as Shown by Corn Yields

Subsoil treatments[1]	*Average yield 1955-58*	*Average increase over untreated subsoil*	*Probability level*[2]
		Bushels per Acre	
Untreated subsoil	95.8	—	—
Effect of lime alone:			
All lime treatments	99.0	3.2	<.01
Plowsole	96.5	0.7	.28
Plowed, 12 inches deep[3]	97.5	1.7	.02
Subsoil cleft, 7-20 in., 21 in. spacing	98.7	2.9	<.01
Subsoil cleft, 7-30 in., 42 in. spacing	103.4	7.6	<.01
Effect of Phosphate alone:			
Plowsole	99.2	3.4	<.01
Effect of Phosphate plus lime:			
Plowsole	97.0	1.2	.10
Increase over lime alone	—	0.5	.68
Plowed 12 inches deep[3]	98.1	2.3	<.01
Increase over lime alone	—	0.6	.37
Subsoil cleft, 7-20 in., 21 in. spacing	96.7	0.9	.19
Increase over lime alone	—	—2.0	<.01
Subsoil cleft, 7-30 in., 42 in. spacing	101.5	5.7	<.01
Increase over lime alone	—	—1.9	<.01

[1] Lime at 8 tons per acre and/or concentrated super-phosphate at 200 pounds per acre P_2O_5. The surface soil of all plots had lime, phosphate and potash added according to soil test requirements.
[2] Probability level of .01 or less is considered as highly significant; those between .01 and .05 as significant; and those greater than .05 as not significant.
[3] Lime at 2 tons per acre was disked into the surface. The soil was plowed 12 inches deep and an additional 6 tons per acre of lime was mixed into the exposed subsoil. The subsoil was turned into place with the surface soil on top again by a second 12-inch plowing.

TABLE 5
Comparison of Lime and Phosphate Deep Placement Methods as Shown by Alfalfa Hay Yields

Subsoil treatments[1]	*Average yield*	*Average increase over untreated subsoil*	*Probability level*[2]
		Tons per Acre per Cutting	
Untreated subsoil	1.10	—	—
Effect of lime alone:			
All treatments	1.10	.00	>.99
Plowsole	1.08	—.02	.64
Plowed 12 in. deep[3]	1.11	.01	.75
Subsoil cleft, 7-20 in., 21 in. spacing	1.09	—.01	.84
Subsoil cleft, 7-30 in., 42 in. spacing	1.08	—.02	.64
Effect of phosphate alone:			
Plowsole	1.14	.04	.30
Effect of phosphate plus lime:			
Plowsole	1.16	.06	.09
Increase over lime alone	—	.08	.04
Plowed 12 in. deep[3]	1.09	—.01	.75
Increase over lime alone	—	—.02	.52
Subsoil cleft, 7-20 in., 21 in. spacing	1.18	.08	.03
Increase over lime alone	—	.09	.02
Subsoil cleft, 7-30 in., 42 in. spacing	1.13	.03	.45
Increase over lime alone	—	.05	.35

[1, 2, 3] See corresponding footnotes, table 4.

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Ontario's Conservation Authority Program

ARTHUR H. RICHARDSON

CONSERVATION has long been a subject of concern to the people of Ontario. Originally this interest centered on the protection of forests because of their importance as a source of revenue, but allied with forest protection were the problems of wildlife management and the preservation of source areas of rivers and streams. In Southern Ontario interest in conservation was first indicated by reforestation and woodlot management. More recently flood control and water conservation, improved land use and development of recreational areas have gained popular attention.

While progress in these activities has been steady, most of the programs, prior to the present time, were initiated by government departments. However, there has been a growing concept of personal obligation, especially where land use problems, farm ponds and small reforestation projects are concerned. Control of flooding and increased summer flow as well as large reforestation projects have come to be considered the responsibility of the community—the community, in this case, encompassing the river valley.

With the advent of this new concept of personal and community responsibility for conservation, the Authorities movement was born, and the willingness of Ontarians to undertake conservation in this way is indicated by the rapid strides made in establishing Authorities during the past 14 years.

The Conservation Branch of the Ontario Department of Planning and Development was established in 1944. It was charged with organizing conservation work in Southern Ontario on the basis of drainage basins, with all the municipalities contained therein working as equal partners.

From the terms of the act which established this department and the scope of work envisaged for the Conservation Branch, as later embodied in The Conservation Authorities Act, it is evident that the field of conservation assigned to it is definitely confined to working with the municipalities *after* they decide to carry out a conservation program within their watersheds. The Branch is, therefore, primarily a planning and coordinating arm of the Ontario Government. This must be understood, because there are four other departments of the Provincial Government engaged in conservation activities responsible for specific phases of Ontario's natural resources.

The large forest empire in Northern Ontario with its problems of timber management, fire protection, reforestation, forest research, fish and wildlife, recreation and related problems is administered by the Lands and Forests Department. Soil management and drainage, farm planning, crop improvement and a multitude of other problems important to farmers of this Province are administered by the Department of Agriculture. The building of dams in the hinterland of the north to maintain lake levels and regulate summer flow is the responsibility of the Department of Public Works. The recently established Ontario Water Resources Commission, Department of Municipal Affairs, has wide powers in the study and control of water problems and currently is actively working on sewage disposal problems and municipal water supplies.

Considering the scope of conservation activities in which these four departments are engaged (and some of them are quite large, for example, Lands and Forests, including permanent and seasonal help, has a staff of 4,200), one may reasonably wonder why the Government of Ontario, as recently as 16 years ago, decided to establish still another department to plan and coordinate conservation schemes. The answer is that this was an entirely new approach in conservation activities directed to assist the municipalities primarily in Southern Ontario.

Conservation Authorities Act

The Conservation Authorities Act was passed by the Legislature in the spring of 1946. It requires that all municipalities within a watershed—cities, towns, villages and townships (not counties)—be included in the body corporate.

Establishment of a Conservation Authority is undertaken by all the municipalities wholly or partly within a watershed. Two municipalities must first petition the Minister of Planning and Development to call a meeting for the purpose of ascertaining whether or not it is desirable to establish an Authority. Two-thirds of the representatives which the municipalities are entitled to appoint (on a population basis) must be present to make the meeting legal. If two-thirds of those present vote in favor, a resolution is forwarded to the Minister requesting that an Authority be established. An Order-in-

Arthur H. Richardson is Chief Conservation Engineer, Ontario Department of Planning and Development, Toronto, Ontario, Canada.

This article is the text of his address at the Fifteenth Annual Meeting of the Soil Conservation Society of America.

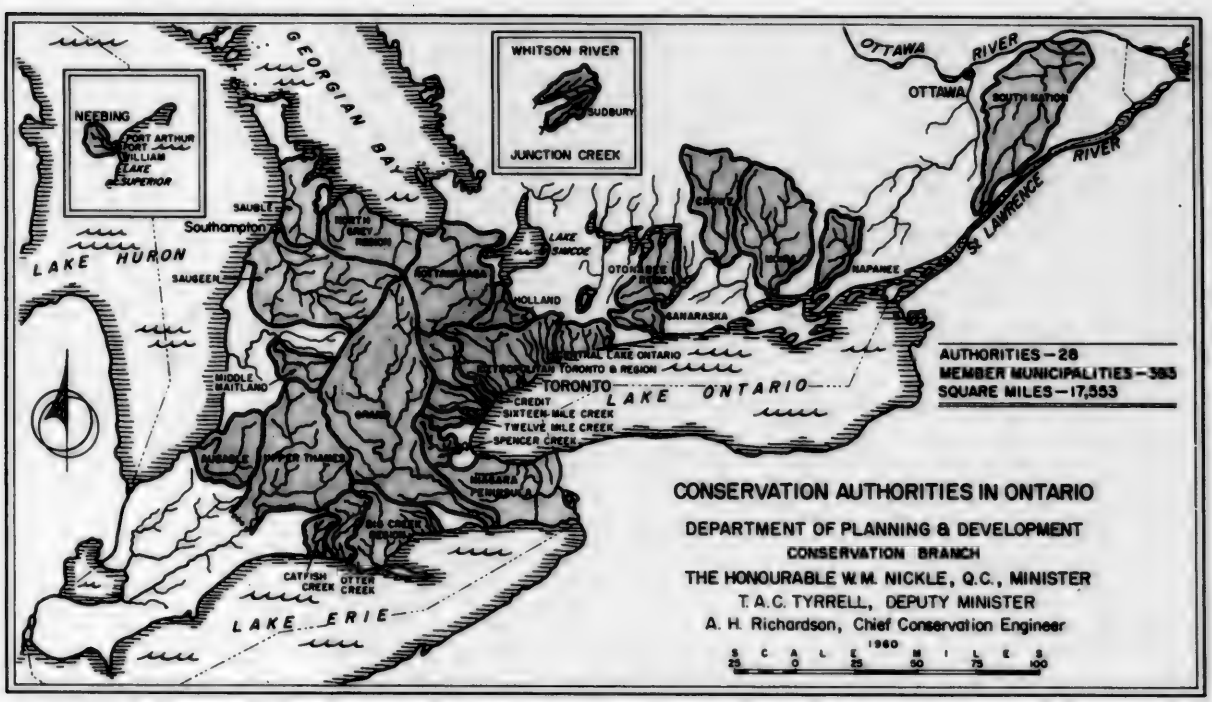

Figure 1. Map showing outline of Conservation Authorities, Ontario Province, Canada.

Council creates the Authority and under the Act the Authority becomes a body corporate with representatives from all the municipalities within the watershed, including those which may have voted against its establishment.

Thus, establishing a Conservation Authority is a simple legal matter. At the preliminary meeting the presiding officer is a senior civil servant, who together with a secretary chosen at the meeting, forwards a report with the resolution to the Minister of the Crown. In some cases minor adjustments have been made in the area under consideration before the Order-in-Council was presented for approval, but not one request for establishing an Authority has been refused.

The Authorities, including a Conservation Commission formed before 1946, now number 29. The area covered by them is 17,553 square miles, and the number of municipalities involved is 393, while the total representative membership is 555.

The accompanying map (figure 1) delineates the areas of each Authority. They vary greatly in size, from the smallest with an area of 86 square miles, a length of 20 miles, and a membership of 8, to the largest with 2,614 square miles, a length of 118 miles and 78 members.

The Conservation Report

While most of the early Authorities were brought into being to control flooding, all were aware of the necessity of such supplementary measures as improved methods of land use, reforestation, proper woodlot management, prevention of pollution, investigation of underground water supplies, fish and wildlife studies and recreation. However, the Authorities were not equipped to carry out the extensive investigations needed to indicate where such work should be done. Consequently, the Conservation Branch of the Department of Planning and Development undertook, at no expense to the Authorities, preliminary investigations. After appraising by means of surveys and statements the conservation needs of each watershed, a detailed report is submitted to the Authority outlining the conservation measures that should be followed.

These reports are in the form of a working plan and are intended primarily for the Authority members. On large watersheds they run to 600 pages, 100 maps and charts, 150 illustrations, and contain as many as 75 recommendations. In addition to the full report, a summary is sometimes published for general distribution.

The survey work which is written into the report is grouped under six general headings: *History, Land Use, Forestry, Water, Wildlife* and *Recreation*. The scope of the study in each of these areas varies according to need. The findings recorded in the completed report are, therefore, directly related to the major problems to be solved.

▸ *History*

A certain amount of historical data is used in each report as a starting point for the study. An attempt is made to get an accurate, local picture of past conditions. Experience has shown that this historical approach is of

Figure 2. Trout fishing in one of the Conservation Areas of the Metropolitan Toronto and Region Conservation Authority. Recreational facility development is an important part of conservation work in Ontario.

Cons. Branch, Ont. Dept. of Planning and Development Photo

great interest to the people within the region studied. It serves to promote an interest in conservation among those who would otherwise remain indifferent.

▸ *Land Use*

The approach to this subject is on a watershed basis with relations among soil, agriculture, forestry and water carefully considered. All existing data are drawn upon heavily in preparing the report. Most important among data sources are the excellent soil surveys made, over the last 24 years, by the Soils Department of the Ontario Agricultural College in cooperation with the Experimental Farms Service. The basic work in physiography by Chapman and Putnam of the Ontario Research Foundation has also been helpful.

▸ *Forestry*

The forestry report provides information regarding the condition and extent of the original forest, the sequence of wood-using industries, forest yields, and conservation measures in progress on the watershed together with recommendations for future conservation measures.

▸ *Water*

Hydrometric and meteorological records kept over the years are checked and tabulated. All available flood records are investigated and related to the gauge records of the river in question. Thereafter the number, size and location of reservoirs required to control floods and regulate summer flow are determined. All small lakes, community ponds and old mill dams are examined and mapped.

▸ *Wildlife*

Wildlife surveys include general inventories of all species of wildlife, both game and non-game, and special study emphasis is given to vanishing or threatened species. Streams are classified as to their condition and suitability for particular species of fish.

▸ *Recreation*

Recreation surveys include estimates of the present and future population of the area served, descriptions of the present use of all recreation facilities by local and outside residents, rating of all recreation facilities, publicly or privately owned, and recommendations for new recreation areas to serve the urban and rural population of the watershed.

Initiation of a Scheme

When the report is presented to it, the Authority must assume responsibility for initiating the schemes which it considers most urgent; it must also approach government departments or other groups from which it hopes to get financial, physical or other assistance.

If, for example, a scheme undertaken by an Authority has to do with land use, it must seek assistance from the Ontario Department of Agriculture. This department maintains agricultural representatives (county agents) in each Ontario county, as well as a large extension service staff at the agricultural college in Guelph, where the department's Soil Advisory Service is located. If the scheme

Figure 3. Senior conservationists visit the hydrologic station of the Ontario Agricultural College at Guelph. Professor N. R. Richards (*center*), head of the Soils Department at the college, explains some of the findings from the soil erosion runoff plots to Dr. E. L. Sauer (*left*), President of the Soil Conservation Society of America; A. H. Richardson, and Don Williams (*far right*), Administrator, Soil Conservation Service, USDA.

Ontario Agricultural College Photo

involves a forestry or wildlife problem, the Department of Lands and Forests is asked for assistance. In the case of flood control the Authority must engage a consulting engineer to do the design and engineering work and supervise the construction. Similarly, when an Authority acquires large "Conservation Areas," which may include parks and recreational facilities, it may be necessary to employ men especially trained in the design of park and recreation areas.

Financing the Authority

Three classes of financing are mentioned in The Conservation Authorities Act. The first is for capital expenses such as dams, reservoirs, reforestation land, and "Conservation Areas." The Authority's share of payment for these capital expenses must be borne by the member municipalities benefiting from the scheme. The second class of financing is maintenance on capital costs and is paid entirely by the Authority which assesses member municipalities. The third finance class is called "administration costs," and includes provisions for payment for all those activities in which an Authority might be expected to engage, not included under capital or maintenance costs. "Administration costs" include items such as salaries and travel expenses, office rent and equipment, tree-planting machines, exhibits, visual aids equipment, printing, farm ponds, the investigation of reforestation lands, and other small conservation projects.

Grants are made by the Ontario Government to all types of conservation schemes with the single exception of maintenance on capital costs. Grants are a matter of policy and may change. At the present time grants for flood control schemes costing less than $5 million are 50 percent; for large-scale reforestation 50 percent of land cost is granted along with 100 percent of expenditures for management. For "Conservation Areas" in which parks are situated, and for the acquisition of flood plain lands as well as all items included in "administration costs," the grants are also 50 percent.

For flood control schemes which cost $5 million or more, the Government of Canada, under The Canada Water Conservation Assistance Act, may contribute 37½ percent of the cost, with 37½ percent granted by the Ontario Government and 25 percent of the cost borne by the Authority. It should be pointed out, however, that the Government of Canada is under no legal obligation to assist the Province in such work. By the terms of the 1867 British North America Act, which united the former colonies into what is now Canada, the control of natural resources was placed under the jurisdiction of the Provinces, and consequently, grants for Authority work can only be obtained by altruistic persuasion.

Advisory Boards

All important decisions must be made by the full Authority, but in large Authorities an executive carries out the routine work. However, in nearly all cases the most active unit is the Authority Advisory Board. Under the Act, the Authority may appoint advisory boards

Figure 4. Guelph dam is a small structure built by the Grand Valley Conservation Authority on the Speed River at Guelph.

Cons. Branch, Ont. Dept. of Planning and Development Photo

(committees) to study and report on any subject related to the Authority's work. Such boards deal with the preliminary work in the following subjects: flood control, public relations, farm ponds and little dams, reforestation, land use, parks and recreation, and historical properties.

As membership on these boards is not limited to Authority representatives, it provides a splendid opportunity for assistance from all groups interested in conservation; and while the final decisions must be made by the accredited Authority members appointed by the municipalities, through the operation of advisory boards the work of conservation can become the personal concern of each individual living in the valley.

In Conclusion

The Conservation Authorities movement in Ontario is still a comparatively recent program. Much has been done since the Act created Authorities 14 years ago, but a great deal more conservation work is necessary. It may be too early to appraise the shortcomings and successes of all Authorities, but I shall venture three observations.

The most active Authorities are those in which there was a healthy interest in conservation among the civic leaders, the press and the people in general, prior to Authority establishment. This same interest, abetted by the fact that the people now have power to plan and build in their own community, has been carried over to the Authority in action.

Rapid progress has also been made since the Ontario Government began appointing field officers to direct and coordinate Authority work. Progress is difficult in a large Authority if members, who are otherwise engaged in making a living, must find time to plan and carry out the broad program of conservation which the whole watershed demands. These fieldmen are employees of the Conservation Branch, with salaries paid by the Ontario Government and expenses paid by the Authorities. Thirteen fieldmen, assigned on the basis of Authority size, are now employed.

Finally, the Authorities achieving the most in this program—there are a few which have not been too active—are those that have envisioned the true meaning of river valley development as being the co-operative effort of all the people living within a watershed. Some problem areas, because of their urgency, must be dealt with first and others must wait, but the valley *must* be considered as a unit. Perhaps the most difficult concept to teach our people is to compel them to turn their conservation thinking not inward, but outward; not to dwell on what the Conservation Authority can do for one's self, but rather, what conservation, with its multiplicity of good things, can do for all people.

Conservation Authority Achievements	*Units*
Large Dams (*each cost approximately $5,000,000*)	3
Small Dams (*each cost $1,000,000 or less*)	13
Channel Improvements (urban)	15
Community Ponds	14
Farm Ponds	2,350
Flood Plain Land Acquisition (*urban*)	acres—1,650
Gauging Stations (*64 staff—22 automatic*)	86
Authority Forests (*reforestation of 45,000 acres*)	14
Private Land-holder Assistance (*5,500,000 trees planted*)	
Conservation Areas[1] (*25,000 acres*)	86

[1] Conservation Areas include woodland, fringeland of reservoirs and ponds, swampland and land use demonstration areas. Where suitable land is included in these areas, parks are established. At present there are 46 parks covering 3,500 acres.

Alfalfa to Replace Sweetclover for Dryland Green Manure Crop Rotations in the Pacific Northwest

JOHN L. SCHWENDIMAN AND VERLE G. KAISER

DURING THE PAST 20 YEARS, legumes and grasses have become a cornerstone of conservation farming in those areas of the Pacific Northwest that receive 16 inches or more annual rainfall. Green manure crops are used in rotation with grain, field peas, and other soil depleting crops.

Biennial sweetclover has been the most important legume used in this system of farming. Prized for its high production of green material, deep penetrating taproot, and ability to fix large amounts of nitrogen, it has beneficial effects on following-crop yields and it conserves the soil.

During the peak years of sweetclover popularity, 1952-1955, about 150,000 acres were planted annually by farmers in eastern Washington, northern Idaho and northeastern Oregon. An equal acreage was plowed under each year for green manure.

Sweetclover's effectiveness as a soil improving crop has been greatly reduced during the past 6 years. Consequently, a gradual decline in clover acreage has occurred, with a major decline in the 1958 season.

Clover plantings in the Pine Creek Soil Conservation District in Whitman County, Washington, are typical of this trend. Figure 1 shows the acreage of green manure plowed under each year in the Pine Creek Soil Conservation District between 1943 and 1958. The data show that clover plantings first increased in acreage, reached a peak, and then declined rapidly.

Sweetclover Yields Decline

Poor sweetclover performance is an important reason for reduction of sweetclover green manure acreage. Farmers no longer raise the good clover crops they did 20 years ago, and hence get proportionately less benefit from them.

John L. Schwendiman is plant materials technician, Soil Conservation Service, U. S. Dept. of Agriculture, headquartered at Pullman, Washington. Formerly Plant Materials Center Manager and agronomist, he now works in eastern Washington, eastern Oregon and northern Idaho.

Verle Kaiser is agronomist, Soil Soil Conservation Service, U. S. Dept. of Agriculture, with offices at Spokane, Washington. A former area conservationist, he now works in the dryland areas of Washington, Oregon, and Idaho.

Figure 2 shows the average annual yield of sweetclover and Bromar mountain bromegrass in trials at Pullman, Washington, during the period 1940-1957. The data show that although seasonal variations affect green manure crop yields to a slight degree, there has been a sharp trend toward lower yields after 1950. Farmers in the area experienced a similar or an even more severe decline in clover yields during this period.

Four factors, singly or in combination, have reduced sweetclover yield in the Palouse. They are:

- Poorer clover stands and poorer plant vigor resulted from competition of the young clover plants with cereal grains used as companion crops; competition was further increased when nitrogen fertilizers were used to increase the yield of grain.
- Vigor and growth of clover plants was reduced by injury from 2,4-D when the grain crop was sprayed to control annual weeds.
- Growing clover plants were destroyed by the clover weevil which became epidemic over the Northwest after 1955.
- The possible existence of an undetermined factor related to soil fertility, soil structure, soil microbiology, or some other deficiency produced "legume sickness." This factor seemed more prevalent on some soils than on others.

Companion Crops and Nitrogen Fertilizer

In the 1930's, most sweetclover fields were established with dry field peas or without a companion crop. Clover stands established with peas were 80 to 90 percent as good as those seeded without companion crops, except in years of below average rainfall during the growing

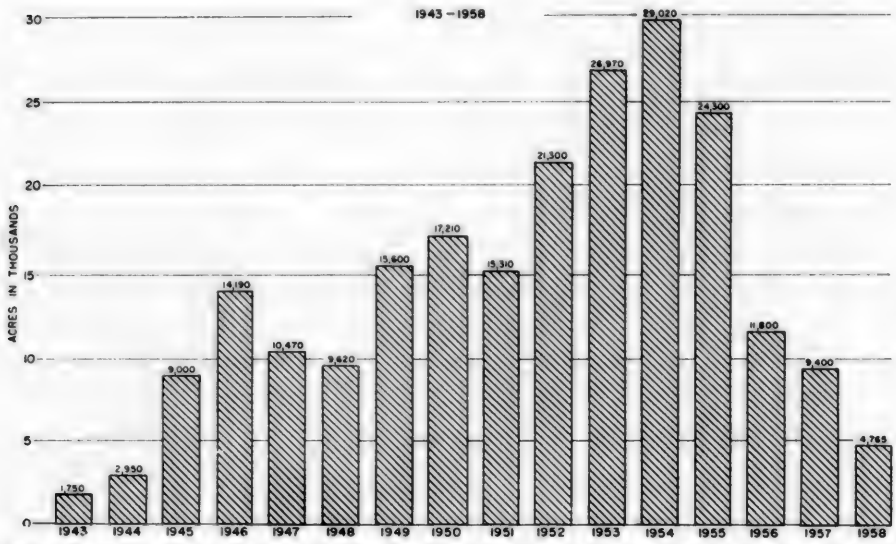

Figure. 1. Acreage of green manure crops in the Pine Creek Soil Conservation District.[1]

[1] Data for this report were taken from Soil Conservation Service reports and the records of other Services.

season, or with unseasonably hot weather at pea harvest time.

Introduction of commercial nitrogen fertilizer in the late 1940's made annual grain cropping profitable and farmers began using spring barley and spring wheat as companion crops for sweetclover.

The overall effect of companion crops and fertilizer on sweet clover yields has been studied at several locations.

The effect of establishment method on sweetclover-grass yields are shown in table 1. This trial was conducted annually at the Soil Conservation Service's Plant Materials Center, Pullman, Washington, during the period 1949-1954. Data were also collected in this study to show the effect of seeding sweetclover in solid stands with barley, but no work was done on seeding with spring wheat. Results from other studies and from farmers' experiences show that sweetclover-grass yields were considerably less than those shown in table 1 when full spring grain seeding rates were used.

TABLE 1
Average Yield per Acre of First Year Companion Crops, and Spanish Sweetclover-Bromar Mountain Bromegrass Top-growth the Second Year as Affected by Establishment Method.

Treatment	*Companion Crop lbs.*	*Sweetclover lbs.*	*Grass lbs.*	*Total lbs.*	*Percent Grass percent*
Clover and grass in alternate rows; no companion crop	——	7,140	1,730	8,870	20
Clover and grass in 6 in. alternating rows over-seeded in peas	1,230	5,672	1,328	7,000	19
Clover and grass seeded together in alternating rows with spring barley	1,930	5,430	740	6,170	12

Data taken during 2 years of this 6-year trial show that sweetclover-grass topgrowth and root production were reduced by the use of companion crops. The root growth averaged 2,200 to 2,800 pounds of air dry matter per acre to an 8-inch depth. Grass roots accounted for 51 to 64 percent of the total.

A field trial at Genesee, Idaho, carried out by the University of Idaho Agricultural Experiment Station and Extension Service in cooperation with the Soil Conservation Service in 1955-56 gave substantially the same results. Data from this trial are summarized in table 2.

TABLE 2
Sweetclover-grass Topgrowth and Root Production as Influenced by Comparison Crops, 1955-56, Genesee, Idaho
(Idaho Agricultural Experiment Station Data)

	Drymatter production in tons per acre				
	Tops		*Roots*		*Total*
	SC	*Grass*	*SC*	*Grass*	*SC-Grass*
Sweetclover alone 7 in. rows	3.14	—	.60	—	3.74
Sweetclover in alternate rows with orchardgrass	2.59	1.60	.92	1.01	6.12
Sweetclover with solid seeded spring barley	2.66	—	.61	—	3.27

The lowest sweetclover yields resulted from a full companion-crop seeding of spring barley. Highest yields of both tops and roots were obtained from the sweetclover-grass mixture. The root production of the mixture was more than 50 percent grass. Not only has this proved desirable in improving soil structure, but the contribution made by orchardgrass in alternate rows with sweetclover is important in adding organic matter and reducing erosion. The tolerance of grass to 2,4-D, its immunity to sweetclover weevil, and its greater production of fibrous roots makes its inclusion in mixtures with

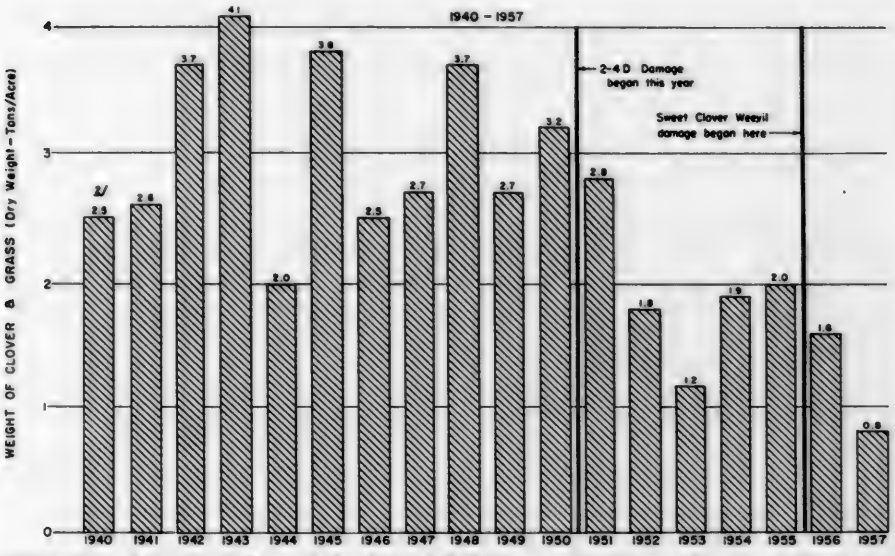

Figure 2. Yield of sweetclover and grass for green manure.[1]

[1] Data from Agricultural Research Service and Soil Conservation Service Experiment Station at Pullman, Washington. Sweetclover and mountain bromegrass without companion crop.
[2] Weights taken at early bloom stage of clover when it was plowed for green manure.

sweetclover a guarantee of good ground cover even if sweetclover fails.

A further deleterious effect on clover yield comes from stepped up use of nitrogen fertilizer on companion crops. Data collected at the Plant Materials Center in 1956 and 1957 are shown in table 3.

Sweetclover and barley yields both show response to sulphur as shown in table 3, but the most commonly used nitrogen fertilizers do not contain sulphur. The use of nitrogen alone at rates of 40-120 pounds per acre stimulates both barley and grass production. The increased competition is detrimental to sweetclover.

TABLE 3

Fertilization Effect on Production of Sweetclover and Grass Topgrowth in Air-Dry Pounds per Acre When Seeded with Hannchen Barley[1]

Treatment	*Barley yield*	*Green Manure yield per acre*		
	per acre	*Sweetclover*	*Grass*	*Total*
Check (No fertilizer)	2,225	2,085	1,759	3,844
48 lbs. of sulphur	2,430	2,621	1,618	4,239
40 lbs. of nitrogen	2,770	812	2,003	2,815
80 lbs. of nitrogen	2,850	574	2,316	2,880
120 lbs. of nitrogen	2,975	439	2,872	3,311

[1] Yields are averages of seedings made in solid stands with the barley seeded 60 pounds per acre and in alternate rows with barley seeded 30 pounds per acre.

Sweetclover Yield Affected by 2,4-D

Use of 2,4-D for weed control began in 1945. By 1950 it had become an established practice on wheat farms in the Northwest. Much of the 2,4-D is now distributed by aerial application. Sweetclover, being extremely susceptible to 2,4-D, has suffered greatly from the drift of spray materials as well as from direct application.

Prior to the universal use of 2,4-D, field data show that 2 year old sweetclover-grass mixtures produced 10,000 pounds of topgrowth and 3,000 pounds of air dry root growth per acre. Yields of comparable areas during the 1955-58 period averaged 4,000 pounds of topgrowth and 1,500 pounds of root growth. Grass production has remained at a constant level and, therefore, on a percentage composition basis grass has actually increased. These data were collected from fields in which companion crop competition, nitrogen fertilization, and sweetclover weevil damage were not factors.

Figure 3. A normal sweetclover plant on the right and a plant severely injured by 2,4-D on the left. Injury occurred on this second year plant in mid-May when it was 12 inches tall. Growth stopped, and the season's growth was reduced by more than 50 percent.

Soil Conservation Service Photo

Figure 4. Spanish sweetclover on the left and Ladak alfalfa with orchardgrass on the right established without a companion crop. The sweetclover shows a trace of 2,4-D damage. This green manure growth was reached 14 months after planting at the Plant Materials Center, Pullman, Washington.

The sweetclover produced 11,700 pounds of dry matter containing 167 pounds of nitrogen per acre. The alfalfa-orchardgrass produced 10,300 pounds of dry matter containing 165 pounds of nitrogen per acre. In the alfalfa-orchardgrass mixture 29 percent of the total nitrogen was contained in the grass.

Soil Conservation Service Photo

Figure 5. W. R. Spencer (left), area conservationist, and the late Carl Freeze stand in a sweetclover-grass field planting in eastern Washington. The use of barley as a companion (robber) crop on the left practically eliminated the stand of sweetclover. No companion crop was planted in the field to the right.

Light to serious damage has been detected in every clover field examined in Whitman County, Washington, and Latah County, Idaho, since the use of 2,4-D became common.

Sweetclover Weevil

The original infestation of sweetclover weevil in the Northwest was reported from Spokane County in 1942. Since then it has spread until few areas escaped its effects in 1958. Several hundred fields were checked in Washington and Oregon east of the Cascade Mountains, and in Idaho during 1958 and 1959. The only locations where no weevil damage was noted were sweetclover fields in Idaho and Nez Perce counties in northern Idaho and in the Soda Springs area of southeastern Idaho. In some areas as much as 50 percent of the plants' leaf surface was removed by weevils in second-year sweetclover stands and the yield was less than 25 percent of normal. As a result, farmers plowed their clover fields at least a month earlier than is desirable. The winters of 1957-58 and 1958-59 were extremely mild and no doubt more weevils survived than would normally be expected; however, there has been a steady increase in weevil damage to sweetclover over the past five years, regardless of winter weather. Large bands of transient sheep, once quite common in the area, are now quite rare because sheepmen can no longer find vigorous, growing fields of sweetclover.

Damage to sweetclover by the weevil has been the latest of the "four troubles" but it has, perhaps, had more to do with decisions against planting it than any other factor operating to reduce acreage.

The control of sweetclover weevil with insecticides has not been economical, since more than one application is usually required. Recent research in Iowa has shown that granular DDT has proven more effective than the dust of DDT or the dust or liquid form of Heptachlor. Dusting pea fields with DDT for pea weevil control has also been effective in controlling sweetclover weevil. Sweetclover established with peas has thus performed more satisfactorily than when established alone unless such fields were also dusted for weevil control.

The observation that yellow blossom varieties are less susceptible to weevil damage than white blossom varieties does not offer a solution to the problem, for both varieties suffer weevil damage in areas of severe infestation.

"Legume Sickness"

Farmers, particularly in cut-over timbered areas and on residual soils in the higher rainfall portion of the Palouse, have had trouble establishing and producing satisfactory legume crops. Especially during the past ten years, alfalfa, red clover, and white clover, as well as sweetclover, have been difficult to establish. Whether the cause is deficiencies of plant nutrients in the soil, changes in soil structure, biological or other unknown factors, is yet to be determined. Legumes have shown response to sulphur, boron, and molybdenum applications on deficient soils.

Damage by "legume sickness" has occurred largely on soils developed under forest cover. Rarely has it been reported on prairie soils. Since a considerable part of the total sweetclover acreage is produced on prairie soils, the effect of "legume sickness" is less important in reducing sweetclover acreage than the other three factors. It is possible, however, that the "legume sickness" problem may be developing on prairie soils.

Suggested Alternatives

Farmers and agricultural workers of the area are gravely concerned over the possible loss of sweetclover as a soil building crop and are asking how it might be replaced. Any replacement should approximate the advantage sweetclover has had and eliminate all or most of the disadvantages. Sweetclover's advantages are: (1) low seed cost, (2) rapid development and establishment of seedlings with a wide variety of companion crops, (3) high yield of organic material, (4) high return of nitrogen when plowed under for soil improvement, (5) suitability for short rotations, (6) utility for pasture or hay, and (7) subsoiling effect of a tap root system.

Substituting alfalfa for sweetclover in the rotation offers the best possible solution to the problem. A comparison of the two legumes shows:

1 At the normal price of $.20 a pound for sweetclover and $.40 for alfalfa, the cost of alfalfa seed would be approximately $1.00 more per acre. However, seed cost is only a small part of the cost of raising and utilizing a green manure crop.

2 Young alfalfa plants appear to have slightly less seedling vigor than sweetclover, but alfalfa can be established under lower rainfall conditions than sweetclover. Young seedlings and mature plants of alfalfa both have much higher resistance to 2,4-D damage than does sweetclover.

3 Alfalfa develops a deeper, larger and more extensive root system than sweetclover. Because of its perennial nature and greater percentage of lignin and other fibrous material, alfalfa roots and crowns decompose more slowly than sweetclover. Residual beneficial effects of alfalfa are greater and last longer in a conservation cropping system. The greatest total benefits are derived when a grass is used in addition to the alfalfa. An adapted grass along with alfalfa or sweetclover used for green manure increases the total organic matter produced. Grass roots are especially effective and persistent in a conservation rotation.

Soil Conservation Service Photo

Figure 6. Spanish sweetclover plant on the left shows severe injury from the sweetclover weevil. Ladak alfalfa plant on the right indicates normal growth and immunity to injury. Plantings were made in mid-April. Sweetclover showed severe injury with three-fourths of the plants having more than 50 percent of the leaf area removed. Only 10 percent of the sweetclover plants survived the first season.

4 During the early period of green manure study (1935-1945) at the Plant Materials Center in Pullman, sweetclover in *two* years produced almost twice the tonnage of organic material and a third greater yield of nitrogen per acre as compared to *three* years of alfalfa. During the period 1945-54, *two* years of clover and *three* years of alfalfa were nearly equal in these respects. Since 1954, alfalfa in *two* years has consistently equalled or exceeded *two* years of sweetclover as far as soil improving benefits are concerned. On farms in the area, the comparison of alfalfa and clover is even stronger in favor of alfalfa because it shows less damage from 2,4-D and weevil.

5 Alfalfa can be used in short rotations. Farmers have found that alfalfa in a three-year rotation is practical. In addition, alfalfa has greater "flexibility" in soil conserving crop rotations than sweetclover. Clover must be plowed down in two years, but if economic or other reasons demand it, alfalfa can be left growing 3 to 5 years or more. This has practical application in fields including both Class III and IV land. The entire field is seeded to alfalfa and grass. At the end of two years, the Class III land is plowed and cropped, but the Class IV land is left for another year or two of additional soil protection.

6 Both alfalfa and sweetclover are valuable pasture and hay crops. During the period 1943-46 experiments carried out at Pullman by the Washington Agricultural Experiment Station and the Soil Conservation Service showed these results: Alfalfa-grass mixtures were equal to second year sweetclover-grass mixtures when grazed by yearling steers. Both mixtures produced 223-308 pounds of beef per acre. Dry matter yields of sweetclover-grass roots and tops averaged six tons per acre for the period 1942-54, but they declined to less than two tons per acre for the period 1954-58. The dry matter yields of alfalfa-grass, roots and tops have continued at three tons per acre.

Other Considerations

While sweetclover weevil damage has been observed on young alfalfa plants, when they are growing in close proximity to badly infested clover fields, permanent plant injury has not been observed. Moreover, entomologists assert that drastic curtailment of sweetclover acreage will lower the weevil population and the associated injury to alfalfa.

Alfalfa weevils have been reported only in isolated areas in the Northwest and as yet are not a problem. Moreover, practical relief from this pest seems possible with resistant varieties, including Lahontan, and the increase in natural weevil predators.

It is a common experience of farmers, and backed up by research, that the beneficial effects of alfalfa last longer in the soil than do the effects of sweetclover. This is explained partly by the fact that alfalfa normally is grown for a longer period in each rotation cycle than is clover, and also by the fact that organic material in the alfalfa plant (particularly in the roots) breaks down more slowly than this material does in the sweetclover plant.

Increasing Alfalfa Use for Green Manure

The recognized standard hardy alfalfa for one hay crop areas is Ladak. The new variety Vernal has also been performing well. These two hardy varieties are recommended for dryland green manure plantings. Ranger is the variety for irrigated green manure. Lately the new variety DuPuits and the blend "Terra Verde" have been offered for green manure use. The practice of plowing under alfalfa in the same year it was seeded or early the following spring does not apply in the Northwest.

Non-hardy alfalfas are being used in the Midwest for green manure. They grow faster than hardy varieties during the short length days of spring and fall, but there is no evidence that they produce more total top or root growth. Several varieties are now being compared for green manure use at the Pullman Plant Materials Center.

There has been a gradual replacement of sweetclover with alfalfa for use as a green manure crop. In view of the drastic sweetclover acreage decline, this trend needs to be rapidly increased. In the Pine Creek Soil Conservation District of eastern Washington for example, a "nor-

mal" planting of sweetclover has been 20 to 25 thousand acres per year. In 1958, less than 5,000 acres were planted. Alfalfa was stepped up from a normal seeding of 3,000 acres to about 8,000 acres. This indicates a good trend, but the change is not occurring fast enough.

The following positive steps are suggested by agricultural workers in the area of green manure crop rotations of the Northwest:

- In cooperation with Soil Conservation Districts, vocational agriculture instructors, county extension agents, seedsmen, radio, TV, and press, plan and carry out a strong information program acquainting farmers with the benefits derived from using green manure crops in rotations. Alfalfa-grass mixtures should be particularly stressed.
- Work with seedsmen to assure adequate supplies of suitable alfalfa varieties to plant the needed acreage of green manure.
- Work with individual farmers in conservation planning to lay out sound crop rotations including legumes and grasses for soil improvement.
- In cooperation with county agents and seedsmen, set up field plantings and demonstrations to compare alfalfa varieties and to compare alfalfa with sweetclover on farms.

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Soil Conservation Service Photo

Figure 7. Sheep pasturing on a sweetclover-grass mixture in the South Palouse Soil Conservation District, Washington. During the years 1945 to 1954 when sweetclover growth was normal, many flocks spent the summer on the sweetclover fields grown for green manure in rotation with winter wheat.

Modern Maps Materially Aid Watershed Planning

ROBERT H. LYDDAN

MODERN MAPS are becoming increasingly important in planning the development of watersheds. They are particularly valuable in dealing with flood and drainage problems associated with the urbanization of large areas that were formerly farm land. Moreover, forecasts of population, industry, and agriculture for the year 2000 indicate that a sound economy then, requires that such maps be employed in current planning to assure optimum use of each square mile of watershed. In brief, as more of the complex relationships between land and water are discovered, modern maps are becoming more essential for the correct interpretation of the effects of changes in land use.

Summary

Wherever watershed problems become pressing, modern topographic maps will be invaluable to those responsible for solving the problems. In addition to the regular map series, several special maps issued by the Geological Survey have unique purposes for planning land use, especially in areas about to be urbanized. Maps at 1:24,000 scale have been completed for 30 large metropolitan areas. Hydrologic Atlases, which show essential hydrologic facts for zoning flood plains or for determining flood insurance rates, contain a new type of map for specific use in city planning. New techniques for improving the accuracy of flood magnitude and frequency studies for large regions are based on factors measurable on modern maps. It is estimated that by 1963 modern maps will be available for half of the United States.

Maps Aid Planning

The routine use of standard topographic maps by experienced planners is commonplace. Measurement of drainage area size, land slope, length of stream courses, and main-stream channel gradient are everyday uses made by hydrologists. Topographic maps also indicate possible sites for water-supply or flood-control reservoirs, routes for proposed drainage channels. They also are used as a base for geologic and other mapping needed in the collection of detailed hydrologic field data for project planning.

Water problems are likely to be concentrated in and around rapidly expanding urban areas. Paved streets, sewers and storm drains, and cesspools for domestic wastes introduce water problems that have multiplied as urbanization increased. To meet the need for adequate topographic base maps for urban areas the U. S. Geological Survey compiles and publishes 1:24,000-scale maps of major cities. These maps conveniently provide topographic information for the city and surrounding area on one sheet (except for the very largest cities). They are compiled by combining standard 7½-minute quadrangle maps, and as of January 1960 such maps had been published for 30 cities.

Floods cause serious problems in all inhabited regions, but especially in urban areas. Two solutions to urban area flood problems are suggested. The first is to delineate the areas that are recurrently flooded and stop or control urban development within them. The second is to allow development of the areas that are subject to recurrent floods but to provide protection for the occupants. Protection may be direct, with flood walls and detention reservoirs, or indirect, in the form of flood insurance. Good maps are required for definition of the areas subject to flooding, but additional information is needed if the *probability* of flooding is to be introduced.

The Survey is now making a new kind of map that will be very helpful in answering important questions about urban areas subject to flooding. An example is the published Hydrologic Atlas of Topeka, Kansas. This atlas was prepared jointly by the Topographic and Water Resources Divisions of the Survey. The areas inundated by the Kansas River during the floods of June 1935 and July 1951 are outlined on the urban area map. The map and accompanying text present an analysis of the flood history of the Kansas River at Topeka. In addition to the outline of the inundated area, the following data are given or can be determined from the information shown on the map: (1) the elevation of historical floods at any location in the flood plain; (2) the computed frequency of flooding or, expressed another way, the probability of flooding at any point in the flood plain; and (3) the depth of water at time of the selected peak at specific sites. Figure 1, prepared from data contained in the Topeka Hydrologic Atlas, shows some of the important facts that can be obtained from it.

Maps presenting flood data similar to the one for Topeka are now being prepared for several cities in Ohio. The extent of flooding during the January or February 1959 flood (whichever was higher) will be shown. Cities for which maps are proposed include: Barberton, Canton, Chillicothe, Circleville, Columbus, Fremont, Mount Vernon, Newark, Springfield, Warren, Youngstown, and Zanesville. Collection of flood data has been completed, but additional work is necessary for preparation of the topographic maps. It is anticipated that these inundation maps will be available on a topographic base by the time the present mapping program is finished.

Robert H. Lyddan is assistant director, U. S. Geological Survey, Washington, D. C. This article is based on an address by the author at a meeting of the Ohio Forestry Association and is published with the permission of the Director, U. S. Geological Survey.

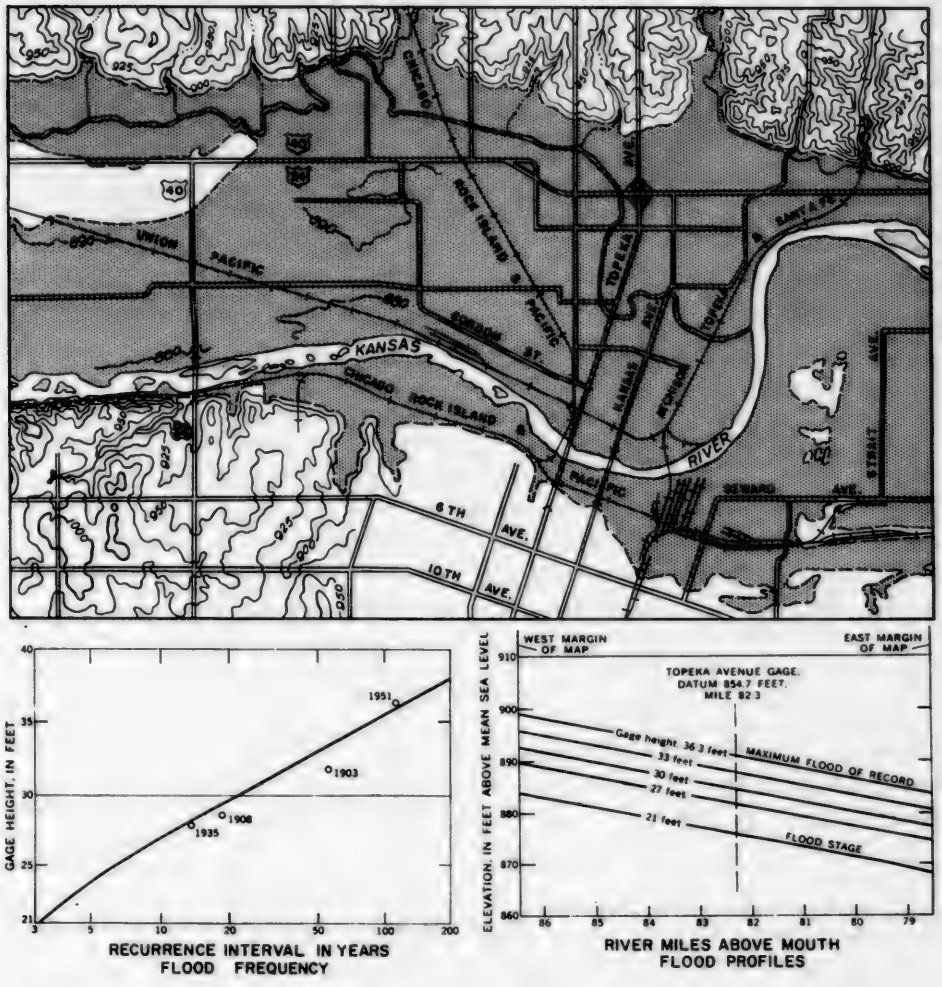

Figure 1. Floods at Topeka, Kansas. The upper map is of the area flooded in 1951. All data were taken from Hydrologic Investigations Atlas HA-14.

Flood Insurance

Topographic maps may be used in a similar manner to outline flood-hazard areas (flood-plain zones). Flood insurance became a popular subject following the major floods of 1955 in New England and the 1956 inundations on the West Coast. In 1956, Congress passed a Flood Insurance Act known as Public Law 1016. This law was never implemented because agreement could not be reached on a workable method for determining flood premiums. If flood insurance is to become a reality, an acceptable method of computing annual premiums must be found. It would not be fair to assign the same premium rate to every building in the flood plain regardless of its location.

A possible solution to this problem is shown in figure 2. A landowner in Zone A is located near the river at a lower elevation than an owner in Zone E; therefore, the landowner in Zone A will be flooded more often. It would then follow that his insurance premiums should be higher. As we move to higher elevations in the flood plain the risk of flooding becomes less. Several zones such as shown in figure 2 could be determined and a premium rate set for each zone. A topographic map of the locality having small enough contour intervals to permit accurate delineation of individual zones would be an absolute necessity.

Rapid Data Processing

Studies of flood magnitude and frequency are important segments of the overall hydrologic characteristics of any watershed. Much research has been done and researchers are continuing to define the physical factors that significantly affect flood magnitude and frequency. Detailed statistical studies of hydrologic factors, formerly too laborious to undertake, may now be performed on electronic computers. One such study recently completed for all of New England shows that in addition to size of drainage area several factors, which can be measured on modern topographic maps, have significant effect on the flood characteristics of the region. These measurable factors are: (1) slope of the stream channel, (2) eleva-

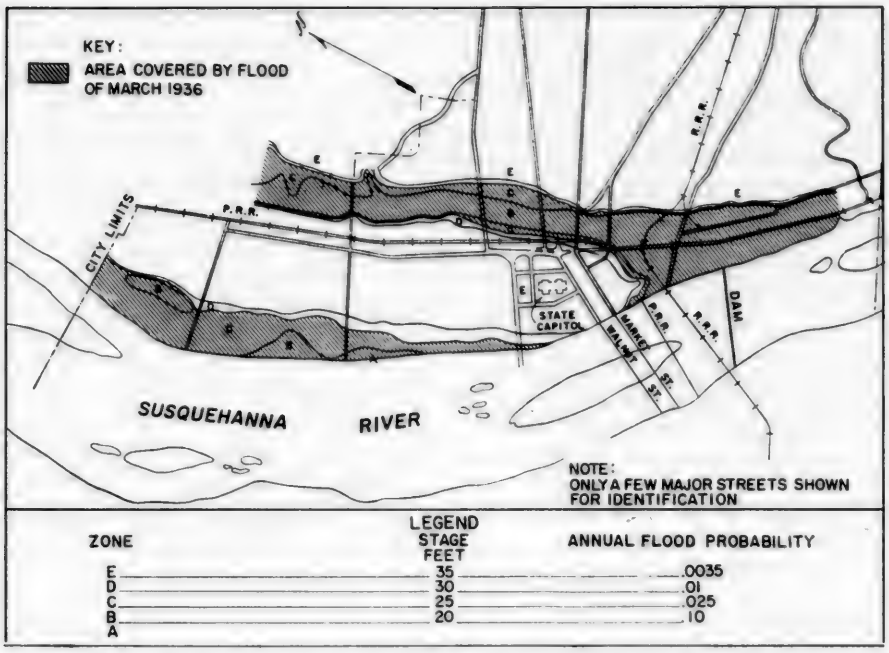

Figure 2. Zones of equal flood probability at Harrisburg, Pennsylvania.

tion or altitude of the drainage basin, and (3) areas of lakes and ponds in the basin.

Similarly, in studies preliminary to selection of a "spillway-design flood" that is to be obtained by the unit hydrograph method, factors measurable from good topographic maps are used to derive regional relationships of effective hydrologic characteristics. When regional characteristics have been defined, it is possible to prepare synthetic unit hydrographs for any basins within the region. Thus, the combination of streamflow records and topographic maps can be combined to solve complex problems in flood hydrology. Pioneer studies of drouth frequency in the humid areas show that good topographic maps are required as a base for plotting geologic features which appear to govern low-flow characteristics of basins.

Status of Mapping

The Geological Survey is engaged in a long-term, nationwide effort aimed at completely mapping the entire country according to specific map-accuracy standards. Ten years ago less than 25 percent of the country was adequately mapped in accord with current standards. By 1963 it is hoped that the half-way mark in this program will be reached, but a guess as to when the whole country will be mapped is hazardous for experience has shown that requirements change from one generation to the next.

Because of the need for modern maps, some States, once entirely mapped by previously accepted standards, have been or are being completely remapped. Ohio was completely mapped at a scale of 1:62,500 by 1916 as a result of a Federal-State cooperative effort started in 1902. These maps, now about 50 years old, served well for many years. Today, however, they are considered inadequate to meet the demands of modern communications, transportation, industry, and agriculture. Larger scale maps with more detailed coverage are required.

In 1959 new maps made according to modern standards had been completed or were in process for about 25 percent of Ohio. Two departments of the State Government took the position that the mapping should be completed much more quickly than that program would permit, and proposed that mapping of the entire State be completed in three years as a joint State-Federal project. That program is now in its first year. It involves about 600 new topographic maps at 1:24,000 scale. The estimated cost is $6.5 million to be shared equally by the State and Federal Governments. The Federal funds are coming from the annual appropriation for the Geological Survey. The State's part is shared equally by the Highway Department and the Department of Natural Resources.

In only seven other States is there complete modern map coverage comparable to that being provided in Ohio. Detail as to the technique of map making, which has been revolutionized during the last two or three decades by the advent of the aerial photograph and the development of photogrammetry, is outside the scope of this article. Of greater interest to watershed planners are the availability of topographic maps in present and future water problem areas, and new techniques for measuring hydrologic factors on those maps. ◻

Christmas Trees—Wise Land Use at a Profit

DONALD G. BURBANK AND LESLIE B. SARGENT

Currently there is active interest in Christmas tree production, particularly among small landowners. And well there might be; the latest figures indicate 25,400,000 Christmas trees were produced in the United States and 12,400,000 were imported in 1955. Retailers generally figure that for every three persons in a village, city or town, one Christmas tree will be purchased. Small, steep, irregularly shaped parcels of land found in many places might be a good Christmas tree plantation site; in addition to conserving the soil they can produce a profit.

It is not the authors' intent in this article to infer that Christmas tree crops are the salvation of all landowners. Rather, it is intended to present an alternative land use worthy of serious consideration. The pursuit of this land use is dependent upon many factors; sound technical information is essential if the landowner is to make an intelligent decision.

Neither is it the intent here to give a short course in how to grow Christmas trees; it is to point out some advantages of this land use and a few considerations necessary prior to making a final decision. Among the more important of these considerations are: site, species, market, spacing, planting method, cultural treatment, tree protection, labor supply, harvesting method, and potential profit.

Site Selection

With respect to site, the soil type, slope, exposure, and elevation are fixed conditions. One must accept these conditions and select a species that will produce on the site available. Balsam fir, Scotch pine, white spruce, red cedar, red pine, Norway pine, black spruce, Norway spruce, red spruce, and white pine are species that have been sold for Christmas trees in the northeastern United States.

Whether a given species will perform satisfactorily on a specific soil type is a complex problem. Some facts and numerous opinions on this subject are readily available in most localities.

Not only must the species selected grow well on the site available, but a profitable market must be found. It is almost impossible to over-emphasize the importance of finding or developing a market. For instance, sheared Scotch pine make beautiful Christmas trees, but in the traditional fir area of northern New Hampshire one would probably still have the entire season's production on hand December 25.

If site conditions force one to plant species not now salable locally, then one must explore new outlets or begin the development of a local market. Different areas of the country favor different species of Christmas trees. The Massachusetts market normally demands a high percentage of spruce and fir; Pennsylvana markets presently call for much spruce and fir also, but the desire for pine is increasing. In some of the larger cites many people have migrated from other localities and this makes it possible to market almost any species of Christmas tree. However, markets do change; a vigorous advertising campaign can create a demand for a certain type tree where there is none today. A good example of this is the growing demand for long needle pines.

A Christmas tree plantation must be geared to produce the trees that meet the size, shape, quality, grade, and price range that the market demands. This is the key to profit, and therefore, it is absolutely essential to plan a market before planting the trees. Once this problem has been resolved, attention must be focused on a source of planting stock, the spacing to use in planting, and the planting method to use.

Planting and Spacing

Planting stock can be purchased from State forest nurseries, private nurseries, grown from seed in one's own nursery, or windlings may be pulled and reset. The choice of species may be influenced by the stock available from any of these sources, as well as by the amount of time one has to secure the planting stock.

Spacing is dependent upon several factors, among which are: size of tree to be sold, amount of land available, and value of land on which planting is to be made. If one has a market for small table trees up to 4 feet high, and little land of high value, then a spacing of 4 feet by 4 feet will be acceptable. However, if plenty of land is available and one is going to produce 8-foot trees, a spacing of 6 feet by 6 feet is more desirable. Spacing is also influenced by the location of roads, weed control methods, planting methods, and harvesting cycle. The number of trees that can be planted on an acre using various spacings follows:

Spacing (feet)	*Trees on each acre*
4 by 4	2722
4 by 5	2178
5 by 5	1742
5 by 6	1452
6 by 6	1210

Donald G. Burbank is work unit conservationist, Soil Conservation Service, with offices at Concord, New Hampshire, and Leslie B. Sargent is Grafton County forester, Grafton County Extension Service, Woodsville, New Hampshire.

U. S. Forest Service Photo

Figure 1. Cutting young balsam fir Christmas tree on private land.

Satisfactory plantations may be obtained by hand or machine planting. Planting machines are generally best adapted to large areas which are relatively level and free of rocks. Some of the newer machines, however, perform well under adverse conditions. Innovations such as side hill adjustments, three point hitches, sod scalpers, etc., make machine planting more practical in rugged territory. Often, machines are available on a rental basis in many areas and prices should be investigated thoroughly prior to making a decision about planting method.

With a three point hitch machine having a side hill adjustment and scalper the authors have been able to plant an average of five hundred trees an hour on a wide range of sites. A three-man crew was used, including the tractor operator. One man followed along behind the machine, filled in the gaps and checked each tree planted to make sure it was firm and at the proper depth.

Hand planting is slower than machine planting, but trees can be put on rougher sites with less experienced help. Crews without some experience in hand planting should be closely supervised. Mechanization of some portions of the hand planting process can speed up the work and make it easier. Where planting bars have been used on tractor wheels and scalping done with a plow, the planting costs compare favorably with machine planting on better sites. Although it is important to get the best job done for the least cost, this is not the place to attempt to save money.

Tree Care

Depending upon the species planted, the rate of growth and other factors, one can expect to harvest at least a part of the Christmas trees from 6 to 12 years following planting. Dureing this period between planting and harvest, continual effort must be exerted to improve the quality of the growing stock through pruning, shearing, weeding, protection, and fertilization. If the trees grow too rapidly, it may be necessary to prune them from the bottom and/or cut back the leaders. Judicious pruning is necessary to form a well shaped tree.

Where brush encroachment is a problem it is necessary to weed out this material constantly if quality trees are desired. To date nearly all brush control has been by cutting or mowing. Recently, developments in aerial applications, as well as mist-blower and broad-jet treatments, have presented a cheaper method of accomplishing this job.

Protection of Christmas trees from insects, disease, fire, and wildlife is an important consideration. Insect and disease resistant species are excellent if they can be obtained, but this is not usually the answer. It is important to be able to recognize damaging diseases and insects immediately upon their appearance and then know which control measures to apply. Some of the newer methods of applying weed and brush killers can be adapted to apply fungicides and insecticides cheaply.

Fire protection can take on several aspects. It should be remembered that a minor ground fire can rapidly wipe out an entire plantation if not brought quickly under control. Therefore, prevention rather than control may be the most practical answer to this problem. If Christmas trees are not planted in high hazard areas, heavy concentrations of logging slash are kept cleared away, and fire lanes are maintained around planted areas, the fire hazard is greatly reduced. A nearby source of water should also be an important consideration in planning fire protection.

The damage that can be done by deer, squirrels, some songbirds, and other wildlife must be recognized. It is well to keep in mind that tree species not native to an area will attract wildlife from considerable distances. Certainly it would not be wise to place a plantation adjacent to a known deer area, any more than one would want to open up a planting to heavy grazing.

Slowly growing, poorly colored trees may indicate a need for fertilizer. Controlled fertilization may prove beneficial and can turn an apparent loss into a gain if handled properly.

Harvesting

In the northern areas an early, heavy snowfall often makes harvesting in remote areas impossible. The only answer to this problem is that harvesting must be considered in site selection.

Trees can be sold on the stump, roadside, or delivered. Someone else bears the burden of getting them out when stumpage is sold. However, this is not always the most

profitable marketing method. If trees are cut with one's own crew different problems arise. In quarantine areas it is necessary to have the trees inspected; some inspectors wish to examine the standing trees, others will inspect them after cutting.

Trees may be graded and this can be a means of obtaining much better prices for there are standard U. S. grades established for all Christmas trees. If trees are bundled then the labor of doing this will be an added cost.

The practice of tagging, or marking in some way, every tree that is to be harvested, prior to letting in the cutting crew, is recommended. This will prevent misunderstandings and the cutting of undesirable trees that could be pruned or sheared and allowed to develop into salable trees. Many growers find that experience gained in developing markets and handling wild trees during the years their plantations are developing gives them good experience and an insight into the problems of harvesting and marketing.

Some growers are developing a clientele who like to cut their own trees and are willing to pay for the privilege, others are choosing to auction their trees. This is a relatively new method of Christmas tree marketing; some growers report favorable results while others turn thumbs down on it.

If one has selected a good site, produced quality trees, harvested them properly, marketed them to good advantage, and not been snowed in on November 1, the figures in the following table, based on 1,000 trees planted, might apply.

Expenses		*Returns*	
Seedlings (State nursery)	$ 10.00	Assuming that two-thirds of the 1,000 trees planted will be salable and that $1.00 per tree is a reasonable wholesale price at the plantation, then 666 Christmas trees would bring $666.00	
Planting	25.00		
Pruning or shearing (twice)	30.00		
Weeding (spraying 3 times)	30.00		
Harvesting	60.00		
Taxes	5.00		
Miscellaneous costs	10.00		
Total Expenses	$170.00	Total Returns	$666.00

The foregoing would indicate that the cost per tree was $0.17 and that the profit per 1,000 trees planted was $496.00. It must be remembered that it took 6 years to produce this crop and that the average annual profit is then $82.66 per 1,000 trees planted. If the assumption is made that these costs and returns are reasonably accurate and the landowner is satisfied with the probable returns, then one can truly say, "*Christmas trees are wise land use at a profit.*"

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U. S. Forest Service Photo

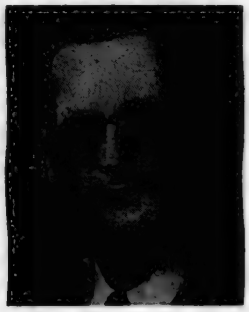
Figure 2. Loading a car with balsam fir for shipment to a market.

Spring Development for Livestock Water

DAVID H. PUGH, JR.

Fresh water is a daily must for human life. A dependable supply of fresh water is essential for crops and livestock. A steady flow of water, as little as two quarts a minute, if collected and stored, will supply 20 gallons of water a day for 35 head of cattle. When it takes half a minute to fill a quart container, this is not a large flow, yet, every day much is being done with extremely small flows of water. This is where the development of springs and cistern use come into the picture.

David H. Pugh, Jr. is agricultural engineer with the Soil Conservation Service, Tappahannock, Virginia.



FARMERS IN VIRGINIA are finding it necessary to develop their springs and seeps and they also find it profitable to use these meager sources of water. Probably the foremost reason for turning to spring and seep development is for a new source of livestock water supply. Wells are often uncertain and usually expensive. Good pond sites are not always present on the farm. And compared with spring or seep development, farm ponds are usually costly.

Another point in favor of spring or seep development is the reclaiming of valuable land for profitable production. The farmer makes operations more efficient by eliminating the wet spot that a spring or seep usually makes. In a real sense he acquires more land, and in many cases this is a sizable area.

In this paper a *spring* is defined as a natural flow of water from the ground surface, usually from a definite opening. A *seep* is similar to a spring but differs in that it has no definite opening.

Developing a Spring

In a spring development, the main objectives are to collect the water, store it and make it available for use. This can be accomplished in three steps: (1) cleaning out trenches into the water-bearing strata; (2) collecting the water in these trenches and leading it to a central point, known as a collection box, and (3) piping the water from this box to the point of use.

As with any other practice, a thorough investigation of the spring development site is essential. This examination may involve borings, test pits or exploratory excavations. In the case of perched or contact springs, the line of seepage can generally be located by observing the presence of water-loving plants. The depth of the water bearing strata can be located by borings with a soil auger.

The dependability of the spring should be thoroughly investigated. The owner of the spring usually knows how water flow held up during periods of drought, but when there is a question as to its dependability, only a partial job of development should be done prior to installing pipe lines and drinking trough, particularly if the pipe lines are a major item of cost. Occasionally, after making the initial drainage of a seep area, the flow is found to be so small or dries up so completely that further expense for its development is not justified.

In some instances, where development cost is low and the need for water is acute, springs which can be depended upon for only eight or nine months of the year have been developed. In other cases springs were developed where the flow was not enough to supply total livestock needs. This was done in the belief that half enough water is better than no water at all. The farmer supplies additional amounts of water by other means.

Water Collection System

The most important part of a spring development is the water collection system. Because site conditions vary widely, there must be different types of collection systems. The best and simplest approach is to design and install a miniature tile drainage system. In most cases, a 4 inch drain tile is laid to grade with at least 6 inches of good filter material on all sides. This filter material usually consists of 1 part coarse sand to 2 or 3 parts gravel, and it is protected with a covering of building paper before back-filling.

A cut-off wall is usually needed in most collection systems to divert water into the tile interceptors and to bring it to a central point. This wall should be 4 to 6 inches thick if concrete is used. It should penetrate far enough into an impermeable layer to prevent any seepage below it or around the ends. A wall 4 to 6 inches above the filter media is usually high enough. Any additional height is usually a waste of materials.

Immediately below this collecting point a spring box is installed. This serves several purposes for it: (1) serves as a part of the collection system, (2) diverts water from the collection system to the delivery pipe, (3) provides

some water storage, and (4) facilitates maintenance by providing a silt trap with easy access for cleaning.

There are two major types of spring boxes. One is termed porous and the other non-porous. The porous type box is placed above the collecting wall and serves as a part of the collection system. The non-porous type is of water-tight construction. Water enters only by way of a pipe, usually a length or two of 4 inch terra-cotta pipe with closed joints.

In most spring developments the non-porous type spring box is used. A concrete distribution box of the type used in septic tank disposal systems makes a very good pre-cast box for this purpose. These boxes come with a removable concrete cover and this makes inspection and maintenance easy.

Delivery Pipes

The delivery pipe is an important part of spring development. It would appear that installing a pipe to deliver water from one point to another would be a relatively simple task, but this is not always the case. This part of spring development has given more trouble than anything else for these pipes have been blocked with silt, particularly where the pipe bends up to enter the drinking trough. Others have been air locked, and plastic pipe has collapsed under a load.

How could these problems have been eliminated?

1 Most silt blocking could have been prevented by using a carefully mixed and graded filter media around the collection tile. The placing of a screen over the inlet end of the delivery pipe in the collection box is always a recommended precaution. Unions should be placed in the delivery line near the spring box and the watering trough. They will facilitate clean out, and should be marked for easy location later.

2 Airlocks in delivery pipes gave a real siege of trouble when plastic pipe was first used in place of rigid galvanized steel pipe. The flexibility of plastic pipe on uneven grades in unstable ditch bottoms quite frequently caused air locks. Where the fall from the spring box to the trough is very limited, a rigid type pipe laid on a uniform grade for the first 10 feet is recommended. Beyond this point, slight changes in grade or even a certain amount of adverse grade does not give any trouble.

3 To prevent a plastic pipe from collapsing it should always be filled with water before back-filling the trench.

Watering Troughs

Location of watering troughs is a matter of judgment. A convenient well-drained site to one side of the drainageway affords a means of overflow water disposal.

Two types of drinking troughs are recommended. A circular reinforced concrete trough about 7½ feet in diameter having a capacity of 500 gallons is favored. However, a pre-cast rectangular trough of reinforced concrete is also used. This type trough has a capacity of about 275 gallons, and has proven popular because of its convenience in installation.

Watering troughs must be constructed with an overflow pipe and it should be at least a size larger than the inlet pipe on gravity flow systems. For example, with 1 inch diameter inlet, a 1¼ inch or larger overflow pipe is recommended. The outlet of the overflow pipe should always be far enough away from the drinking trough so it will not create a mud hole.

Maintenance

A spring development needs and deserves good maintenance. Good design and construction reduce maintenance to a periodic inspection of the development and the cleaning of the screens or strainers placed over the inlet ends of the pipe.

Placing a peeled log in the drinking trough during the winter months will protect the trough from damage due to freezing. On open land areas in the mountains of Virginia soils freeze to a depth of 10 inches and therefore all pipes should be buried at least 18 inches deep. Where there is a sizable and dependable flow of water through the trough, these recommendations may be relaxed.

All spring development systems should be provided with a convenient means of draining for periodic clean-out. Draining removes accumulated sediment and this avoids costly repairs.

Additional Uses of Springs

In addition to providing water for livestock, many Virginia farmers make excellent use of the excess spring water. The owner of a spring development in Giles County (Va.) made effective use of the surplus water by piping it into his home. Next, he started irrigating his garden and about two acres of pasture land and he is now in the process of developing a small fish pond. The heavy flow having a total drop of 885 feet affords him some fire protection for his valuable home and farm buildings.

The development of springs and seeps is one of the most interesting and challenging engineering practices. It has also proven itself to be one of the most popular with the farmers where there is a need for more dependable supplies of livestock water.

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Book Reviews

Power to Produce—The 1960 Yearbook of Agriculture. *By* United States Department of Agriculture. *Edited by* Alfred Stefferud. *480 pp., illus., refs., index, 1960. U. S. Government Printing Office, Supt. of Documents, Washington, D. C. $2.25 (Reviewed by* LAUREN SOTH, *Des Moines, Iowa.)*

The brilliant, amazing story of mechanization of American agriculture has never been told better than in this book which describes the 100-year revolution in substitution of mechanical power for human and animal power in farming.

Thanks to the skillful editorship of Alfred Stefferud, the yearbooks on agriculture are fascinating reading, as well as indispensable reference works. They are written in simple, direct style which makes them useful to everyone from school children to scientific specialists.

The 1960 book on power in agriculture probably is the most comprehensive review of the subject ever produced. It deals with machines for every conceivable agricultural purpose under the general subdivisions: "Power in the Past," "Power in the Present," "Power on the Land," "Power in the Harvest," "Power and Livestock," "Power and the Market," "Power and Efficiency," "Power and Its Effects," and "Power in the Future."

The first chapter, written by Harold E. Pinches of the Agricultural Research Service, lucidly tells the story of man's continuing drive to use more mechanical power—from invention of the wheel to the splitting of the atom. This historical review is supplemented by another chapter with a fascinating selection of quotations from articles in early American agricultural journals, reports of public agricultural officials, machinery manufacturers, etc.

The chapters describing the use of power in agriculture, the new machines, the employment of electricity and so on make a valuable contribution to public understanding of what is going on in agriculture. However, the chapters dealing with the economic and social implications of the revolution in agricultural technology are less than satisfying. They are relegated to the back of the book and are not given the emphasis they should have if the public is to understand the radical changes in farming in our times.

The last article in the book, by Frederick V. Waugh, is an excellent essay on "Benefits for All," describing the effect of the agricultural revolution on consumers. It should be in the front of the book and should have been given more space, with charts and diagrams to illustrate its points.

Not enough Americans yet understand that the great public investment in agriculture in the last 100 years, including the price support subsidies of recent years, have been of very large benefit to the public as a whole. Non-farm people are inclined to think of all this activity of federal and state governments as "hand-outs" to farmers. In fact, the benefits have been and are being transmitted to consumers very rapidly.

Waugh's article touches on the signficant role that American agriculture has played in the total economic development of the country, by releasing great amounts of labor for other uses. This would be worth a chapter in itself to put the agricultural power revolution into focus for the general public.

Power to Produce is an excellent piece of work despite these criticisms, and it will be a valuable reference work for many years to come.

The Conservation of Natural Resources. *By* RICHARD C. HAW. *255 pp., illus., diagrams, app., tables, index, 1959. Faber and Faber, Lts., 24 Russell Square, London. 30s (approximately $4.25). (Reviewed by* A. D. STOESZ, *Washington, D. C.)*

The author, Professor Haw, is an instructor in Soil and Water Conservation at the Dombashawa School in Salisbury, Southern Rhodesia. He writes in an easy, fluent and understandable style, treating the broad subject of natural resources in its widest aspects. While the author draws on his personal experiences from South, Central and East Africa in writing this book, he attempts to cover the dry tropical and subtropical countries of the world. In his endeavor to cover so broad a territory he encounters difficulty in applying examples and experiences that do not always fit a large segment of the country. Nonetheless the book is worth reading in order to gain a broader understanding of the numerous problems and the manifold solutions that are discussed.

Nine chapters are devoted to soil, land use, erosion, and conservation measures. One chapter is devoted to "Farm Road Construction," one to "Water Conservation" and one to "Other Resources." For so broad a subject as natural resources, the book seems to lack balance since it treats certain large segments of conservation rather briefly.

The 16 pages of well chosen half-tone illustrations and 35 diagrams are an aid to better understanding of the text and a help in creating reader interest.

Appendix I (20 pages) is devoted to a description and characterization of the principal trees, shrubs, grasses

and legumes that are used in soil conservation. Included among these are many European and American species.

Appendix II (7 pages) consists of miscellaneous weights, measures, conversion tables and other useful figures of the many countries that are referred to in the text. This is of material help to the reader in comparing data and the results of observations reported from many countries.

The book has several unusual features, among them the excellent treatment on "Farm Road Construction" which is often overlooked in a text of this sort.

The Grasses—Earth's Green Wealth. *By* ALMA CHESTNUT MOORE. *150 pp., illus., bibl., index, 1960. The Macmillan Co., 60 Fifth Avenue, New York 11. $5.00. (Reviewed by* WILSON F. CLARK, *Billings, Montana.)*

"But as (man) seeks the stars he still lacks comprehension of the earth beneath his feet and the debt he owes it."

This line, taken from one of the chapters of Mrs. Moore's book, sums up well the reason for the book, and the reason why it should be widely read.

Many millions of words concerning our resources have been launched on the Stygian sea of public communication media. Most such words drown, unheard, unread, amidst the clamor for the public's attention. But still we need eloquent spokesmen to put forward, repeatedly, the case for the public's understanding of our earth, and our absolute dependence on its basic soil, water, and plant resources. Mrs. Moore is such a spokesman.

The author presents a chapter on each of the major grains and grasses: wheat, barley, corn, rice, oats, bamboo, and sugar cane. In other chapters she considers the land-building function of this family, some aspects of the insect and disease problems of grain and grasses and, finally, the place of grasses in modern conservation operations. Throughout the book there are many interesting historical bits, and a fund of little-known facts about each of the groups covered. As an example of such information, consider this:

> "The straw that is wasted each year in the United States, if used for paper and other products, could take care of the entire needs of the nation for cellulose. Scientific research has the answer to the problem (of sources of cellulose) in cereal straws which are renewed annually, in contrast to wood which takes years to grow. The technique of their use has been perfected by painstaking work and by pilot plant testing. It remains only for industry to take over."

In a very readable, non-technical style, Mrs. Moore has given us a well-indexed, enjoyable, and highly informative book, that will be continuously useful as a reference. For the general reader and for the technical conservationist of any complexion "The Grasses" will be a valuable volume, for it will contribute to that comprehension of our earth for which we all must strive.

River Basin Administration and the Delaware. *By* ROSCOE C. MARTIN, GUTHRIE S. BIRKHEAD, JESSE BURKHEAD, AND FRANK J. MUNGER. *390 pp., index, 1960. Syracuse University Press, Box 87, University Station, Syracuse 10, N. Y. $5.00. (Reviewed by* NORMAN E. LANDGREN, *Ames, Iowa.)*

Water resource management within river basins poses complex organizational and administrative problems. The American experience with regional water resource development has illustrated that there are several organizational structures within which development objectives may be achieved. But this experience has also revealed that none of the organizational structures created to implement development programs in major river basins has been perfect and that all have on occasion proved inadequate to resolve particular problems. The authors of *River Basin Administration and the Delaware* should be commended for their efforts in attempting to distill from the American experience common elements of success in regional water-resource development and to modify and incorporate these elements into a positive proposal for the organizational structure of a water resource development program in the Delaware River Basin. The proposed organizational plan presented in this volume is the product of a research study of "governmental organization for development of the water resources of the Delaware River" by the Syracuse University Research Institute.

The volume is divided into five parts consisting of 19 chapters. Part I introduces the study by describing the Delaware River Basin. Special attention is given to the multiplicity of groups interested in water resource development and to the potential conflicts of interests among these groups.

Part II deals with criteria for evaluating the adequacy of various governmental areas as administrative units. Also considered are economic aspects, legal foundations, and alternative organizational structures underlying regional water resource development.

Part III appraises the financial responsibility and possible sources of revenue for development in the Delaware River Basin.

Part IV reviews the American experience in water resource development. Intrastate and interstate arrangements for administering development programs are discussed and appraised. These chapters draw heavily upon experience in the Lower Colorado, Tennessee, and Missouri River Basins.

Part V presents a proposed organizational plan for Delaware River water resources administration. The authors propose a two-phase plan. The first phase consists of a "Delaware River Agency for Water," which would be created by passage of a congressional statute. States, as well as the Federal Government, would be represented in this agency. The second phase of the plan recommends a Federal-interstate compact creating a "Delaware River Commission."

Three of the authors of this volume are political scientists. The central thesis—organizational structures for water resource development—reflects their interests. A strong section on the economics of river basin development was possibly precluded by the interests of the authors and scope of the assigned study. The infrequent and superficial references to economic considerations do not always demonstrate rigorous application of fundamental economic guidelines. Particularly disturbing to this reviewer was the authors apparent approval of the interest-component and basin-account concepts within river basins and their justification of the possible application of these concepts through the use of such abstruse phrases as "maximum contribution to the economic development of the Delaware Valley."

The contribution of the authors in writing this volume is not the presentation of new analytical techniques or the development of revolutionary organizational structures. Rather, their book illustrates with clarity the problems that arise in developing within an environment of the many diverse publics which it must serve an organizational structure that would be politically viable and administratively competent. This is, indeed, an important contribution.

Resources Development: Frontiers for Research. Western Resources Conference Papers, 1959. FRANKLIN S. POLLAK, *Editor. 315 pp., 17 figs., 20 tables, 1960. University of Colorado Press, Boulder, Colorado. $3.75* (Reviewed by WALLACE E. AKIN, *Des Moines, Iowa.*)

This collection of 23 papers presented by recognized experts in many fields of resources development at the 1959 Western Resources Conference is concerned primarily with the diverse aspects of the resources of the western United States. However, most of the papers contribute to a general understanding of resources for the nation and the world as a whole. The theme of the conference was "building toward a continuing program of graduate study and research in the conservation and development of the resources of the West." The papers are grouped into eight divisions, the titles of which give some indication of their content: (1) "Resources, a Worldwide Concern;" (2) "Western Resources and the National Interest;" (3) "Atomic Energy—Promise and Problems;" (4) "Water;" (5) "Land Use;" (6) "Minerals and Energy;" (7) "Recreation;" and (8) "Vision and the Task at Hand: Research." The conference was sponsored by the University of Colorado, Colorado State University, and Colorado School of Mines.

The diverse nature of the papers and the great amount of information contained in them makes a summary difficult. An underlying theme of many of the papers is the "population explosion" and the repercussions this will have on the future development of resources. Not only increase in population, but redistribution of peoples within the country and the contained shift to urban areas, particularly in the West, are considered in the light of conflicting and changing demands on resources. The role of atomic energy in increasing the energy potential and the problems arising from its use are discussed from the technical and legal aspects. Water, as one might expect, receives the major share of space in the book. New water technology is summarized from the standpoint of demineralization of sea water, weather modification, evaporation control, industrial re-use, and new techniques for locating ground water. The South Platte River is the subject of a symposium concerned with the necessary elements of a master water plan for that river basin. This presentation is followed by a rather sharp criticism of the failure of planners to provide alternative choices in the South Platte and other major water developments in the United States where a "take it or leave it" attitude has prevailed. Representatives of the Harvard Water Resources Program present their development of new approaches to planning and designing multi-unit, multipurpose water resources systems through simulation on high-speed digital computers and mathematical models. Other sections treat land use, minerals and energy, and recreation. The final papers deal with opportunities for graduate study and inter-university cooperation for research in the resources field.

This is by no means an exhaustive treatment of Western resources. Many areas are hardly touched upon in the field of resources problems and development. However, it is a worthwhile publication which presents many challenging ideas and new techniques in planning and government which are applicable, not only to the western United States, but to other areas of the world.

Current Literature Briefs

Conservation of the Camp Site. 36 pp., illus., 1960. American Camping Association, Martinsville, Indiana. $.75. (Reviewed by Ben O. Osborn, Washington, D. C.)

A specialized problem in land use faces the owners and directors of the Nation's 12,000 camps which contain more than a million acres. How to make the most of the natural resources of the camp site while protecting it from the traffic of its users is no less a challenge than growing wheat on the windy plains or vegetables under irrigation.

This booklet tells camp administrators how to meet the challenge. Basically, the answer is the same as would be given to a farmer or rancher: use the land within its capability and treat it according to its needs, following a long-time conservation plan based on a survey and inventory of the resources of the site.

These principles, that have served soil and water conservation so well in agriculture, are equally valid in coping with the growing pressure of population on the recreational resources of the land.

The American Camping Association has performed a valuable service in presenting a straightforward and practical approach to a specialized conservation problem. Although the book names no author on its title page, the introduction gives credit to A. B. Foster of the Soil Conservation Service for much of the text and to Felix Summers, also of SCS, for the illustrations.

Biological and Chemical Control of Plant and Animal Pests. L. P. Reitz, editor. 273 pp., illus., tables, refs., index, 1960. American Association for the Advancement of Science, 1515 Massachusetts Avenue, N. W., Washington, D. C. $5.00.

This book is a collection of 19 papers presented at the symposuim by Section O (Agriculture), AAAS, on December 28-30, 1957.

Excellent papers in three divisions, i.e., "The Public's Stake in Pest Control," "Recent Advances in Chemical Control," "Biological Control of Pests," are worthy of critical consideration.

Hydraulic Research in the United States. 188 pp., index, paper cover, 1960. National Bureau of Standards, U. S. Dept. of Commerce, Misc. Pub. 231. $1.00.

The information contained in this publication was compiled from the reports of 179 hydraulic and hydrologic laboratories in the U. S. and Canada.

A similar report, "Hydraulic Research", compiled and published by the International Association for Hydraulic Research, contains information on such research being conducted in foreign countries. Copies of this work may be obtained for $6.00 from the editor, Prof. J. Th. Thijsse, Director of the Hydraulic Laboratory, Technical University, Delft, The Netherlands.

Water Resources of a Western New York Region. *Erich F. Bordne.* 149 pp., diagrams, paper cover, bibl., 1960. Syracuse University Press, Box 87, University Station, Syracuse 10, N. Y. $3.00.

A case study of water resources and use in the Genessee Valley and Western Lake Ontario Basin.

Water for the Cities. *Nelson M. Blake.* 341 pp., refs., illus., line maps, index, 1956. Syracuse University Press, Box 87, University Station, Syracuse 10, N. Y. $4.00.

This history deals principally with the water problems of New York, Philadelphia, Baltimore, and Boston, during the period 1790 to 1860. The last two chapters, a historical summary, bring the story up to date.

Storage and Flood Routing—Manual of Hydrology: Part 3. Flood-Flow Techniques. *R. W. Carter and R. G. Godfrey.* 28 pp., diagrams, tables, refs., 1960. Geological Survey Water Supply Paper 1543-B. U. S. Government Printing Office, Washington, D. C. $0.15.

Sequence and Timing in River Basin Development—with special application to Canadian-United States Columbia River Basin planning. By John V. Krutilla. 40 pp. 1960. Resources for the Future, Inc., 1145 Nineteenth St., N. W., Washington 6, D. C. $0.75.

Here is a contribution to current economic analysis in river basin planning and project evaluation. The author uses the planning of joint United States-Canadian development of the Columbia River Basin as a means of demonstrating the theory that it is essential to determine the proper sequence of project additions to a system over time, in order to estimate the contribution of particular projects to the system's output and to maximize the net benefits from development. Mr. Krutilla is research associate with Resources for the Future.

ECONOMICS OF WATERSHED PLANNING

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A crisp, comprehensive, one-volume treatment of the economics of watershed planning together with related legal and other institutional matters. Watershed research is reported on. New techniques in economics analysis are applied to planning small watershed development. Differing points of view are expressed regarding the appropriate ways of handling watershed planning and of promoting watershed development. This book is the outgrowth of a TVA sponsored symposium at which 23 authorities in the area of water resources presented discussions, followed by the remarks of 31 commenters to provide a full coverage of watershed problems. 352 pages. 1960. **$3.95**

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Grazed Firebreaks in Southern Forests. *Halls, Hughes and Peevy.* 10 pp., illus., popular style, 1960. Forest Service, Agricultural Information Bulletin Number 226, U. S. Government Printing Office, Washington 25, D. C. $0.10.

Guiding Metropolitan Growth. 54 pp., illus., graphs, 1960. Committee for Economic Development, 711 Fifth Avenue, New York 22, N. Y. $2.00.

This statement on national policy by the Research and Policy Committee of the Committee for Economic Development is of interest, though it touches only lightly wise planning of land use in metropolitan development.

Biochemistry of Plants and Animals. *Mallette, Althouse and Clagett.* 552 pp., tables, diagrams, appendix, refs., index, 1960. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. $8.50.

This text is a general view of the subject at the elementary level, and is intended primarily as a text for undergraduates. It replaces "Introduction to Agricultural Biochemistry."

World-Wide Graduate Award Directory, Volume III. 1959. The Advancement and Placement Institute, Box 99, Station G, Brooklyn 22, N. Y. $3.00.

This is the third volume in an annual series. Each volume lists only those graduate awards not included in previous volumes. Descriptions of specific assistships, fellowships, scholarships, and research grants awarded by universities in the U. S. and 55 foreign countries are included. Information by country, field of study, duration of award, number of awards, amount of stipend, specific requirements, and to whom to apply is given.

This noncommercial service also publishes a monthly non-fee placement journal describing verified professional openings in the U. S. and abroad. This journal offers information on undergraduate scholarships, current graduate awards, summer opportunities and part-time work. Subscription price is included in this institute's $5.00 individual membership fee.

Evolution of Michigan Water Laws: Response to Economic Development. *A. Allan Schmid.* 34 pp., 1960. Circular Bulletin 227, Agricultural Experiment Station, Michigan State University, East Lansing. (single copies free).

Introduction to Geology. *Alfred Livingston, Jr.* 55 pp., 8½ by 11 inches, printed left page only, 1960. N-P Publications, Palo Alto, California. $3.00.

This outline is a revision of an earlier one by the author and is intended to present to students the fundamental priciples of the important concepts in geology. Examples are almost completely eliminated from the text and the blank right hand page provides for permanent recording of notes.

Water Resources Center Progress Report Number One. 34 pp., 1960. Water Resources Center, University of California, Berkeley.

A Primer on Water. *Luna Leopold and Walter Langbein.* 50 pp., diagrams, glossary, 1960. U. S. Government Printing Office, Washington 25, D. C. $0.35.

This is a popular nontechnical pamphlet excellently conceived and clearly written. Part 1 discusses the science of hydrology and Part 2 is concerned with the magnitude and use of the total supply of water in the United States.

Conservation of Natural Resources in the Columbia Basin. 16 pp., line drawings, 1960. National Wildlife Federation, 1412 Sixteenth Street, N.W., Washington 6, D. C. (single copies free)

In brief the bulletin states: "Orderly development of a balanced civilization in America's Great Northwest must include conservation and rebuilding of the salmon runs, preservation of scenic and wilderness treasures, and conservation of game, along with irrigation, power and flood control.

General Introduction and Hydrologic Definitions—Manual of Hydrology: Part 1. General Surface-Water Techniques. *W. B. Langbein and Kathleen Iseri.* 29 pp., line drawings, refs., 1960. Geological Survey Water Supply Paper 1541-A. U. S. Government Printing Office, Washington, D. C. $0.20.

Plant Hardiness Zone Map of the U. S. 22 by 30 inches, color. Information Publications, Agricultural Research Service, U. S. Dept. of Agriculture, Washington 25, D. C.

This map shows in moderate detail the expected minimum temperatures of most of the horticulturally important areas of the continental U. S. It shows 10 different zones, each of which represents an area of winter hardiness for certain ornamental plants.

Estimating the Areas in Logging Roads by Dot Sampling on Aerial Photos. *Karl Moessner.* 4 pps., illus., 1960. Research Note Number 77, Intermountain Forest and Range Experiment Station, Ogden, Utah.

Methods for Collection and Analysis of Water Samples. *F. H. Rainwater and L. L. Thatcher.* 301 pp., illus., refs., index, 1960. Geological Survey Water Supply Paper 1454. U. S. Government Printing Office, Washington, D. C. $1.50.

Review of Literature on Evaporation Suppression. *George Magin, Jr. and Lois Randall.* 18 pp., 1960. Geological Survey Professional Paper 272-C, U. S. Government Printing Office, Washington, D. C. $0.20.

1960 Conservation Directory. 122 pp., 1960. National Wildlife Federation, 1412 Sixteenth Street, N.W., Washington, D. C. $0.50.

The booklet lists the names of over 700 international, national, State and other conservation agencies, and organizations along with names and titles of 3,000 individuals active in conservation work.

Forest and Shade Tree Entomology. *Roger F. Anderson,* 428 pp., illus., host index, general index, 1960. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. $8.50.

This book should prove to be a valuable reference as well as a good text. Section 1 presents the fundamentals of insect structure, physiology, development, classification, and ecology. Part 2 offers a detailed discussion and description of the more important forest insect species.

Questions and Answers on Agricultural Research—In the U. S. Department of Agriculture and the State Agricultural Experiment Stations. 28 pp., 1960. U. S. Government Printing Office, Washington, D. C. $0.25.

Systemic Chemicals for Crop-Insect Control. 10 pp., 1960. ARS special report 22-61, Information Publications, Agricultural Research Service, U. S. Dept. of Agriculture, Washington 25, D. C.

A Priority Scheme for Dutch Land Consolidation Projects. 84 pp., figs., maps, 1960. International Institute for Land Reclammation and Improvement, P. O. B. 45, Wageningen, The Netherlands. $1.50.

A summary in German, French, and Spanish of the English text is included in this publication. Other publications of the Institute include:

An Assessment of Investments in Land Reclamation from the Point of View of the National Economy. 65 pp., illus., maps, 1960. $1.50.

Local Administration of Water Control in a Number of European Countries. *F. Hellinga.* 46 pp., 1960. $1.00.

Some Aspects of Sprinkler Irrigation in Tropical Regions. *J. C. J. Mohrmann.* 24 pp., illus., 1959. $0.40.

Annual Report—1959. 51 pp., illus. 1960.

The volume contains two interesting articles, "Land Development in Spain" and "The Measurement of Basic Resources with Special Reference to Africa." A broad list of literature in the field of land reclamation and improvement is also included.

Water Resources of Virginia. 112 pp., color, illus., 1959. Progress Report, State Soil Conservation Committee, Blacksburg, Virginia.

Economic Evaluation of Water, Part I —A Search for Criteria. *P. H. McGauhey and Harry Erlich.* 237 pp., maps, tables, bibl., 1957. Sanitary Engineering Research Laboratory, Water Resources Center, University of California, Berkeley. (no price listed)

The Water Resources Center Archives reports received include the following titles: Report 2: "Theses on Engineering, Economic, Social and Legal Aspects of Water" (1958); Report 3: "Watershed Management Research Data, U. S. Department of Agricultural, Forest Service, California Forest and Range Experiment Station" (1959); Report 4: "Publications and Reports of Charles Gilman Hyde" (1959); Report 6: "Bachelor of Science Theses on Water Resources Engineering at the University of California" (1959); Report 7: "Theses on Water Resources, Stanford University, California Institute of Technology, and University of Southern California" (1959); and Report 8: "The Early Pacific Photographs of Carleton E. Watkins" (1960).

Factors Affecting Moisture-Storage Efficiency of Dryfarming Areas in the Great Plains. *H. H. Finnell.* 16 pp., 1960. ARS Production Research Report Number 37, Information Publications, U. S. Government Printing Office, Washington, D. C. (no price listed).

Some Aspects of the Shape of River Meanders. *Ralph Bagnold.* 14 pp., diagrams, 1960. Geological Survey Professional Paper 282-E, U. S. Government Printing Office, Washington, D. C. $0.20.

Floods in Ohio. *W. P. Cross and E. E. Webber.* 352 pp., illus., bibl., index, 1959. Bulletin 32, Division of Water, Department of Natural Resources, 1562 West First Avenue, Columbus 12, Ohio. $5.00.

Our National Water Resources. 35 pp., 1960. Economic Problems Department, National Association of Manufacturers, 2 East 48th Street, New York 17, N. Y. $1.00.

This booklet presents the statements of Donald J. Hardenbrook before the Senate Select Committee on National Water Resources, and the statements of Leonard E. Pasek and Daniel W. Cannon before the Public Works Committee of the House of Representatives. The official policy positions of the NAM dealing with water resources is also part of this material.

UNIVERSITY OF Chicago PRESS

PRIVATE GRAZING AND PUBLIC LANDS

Comparative Studies of the Local Management of the Taylor Grazing Act

By Wesley Calef. The Taylor Act of 1934 allows public domain land in the western states to be leased to cattle-raisers for grazing purposes. Focusing on the Rocky Mountain area, Mr. Calef poses the question: How well has this law worked? What can be done to improve it? He concludes with recommendations for changes in the use and management of western Taylor grazing lands. Illustrated, index. $9.50

WATER SUPPLY

Economics, Technology, and Policy

By Jack Hirshleifer, James D. De Haven, and Jerome W. Milliman. A book of major importance — thoroughly assesses our water resources and utilization, and demonstrates that existing supplies are grossly misallocated. Alternative lines of future development are suggested, together with economic criteria on which water supply use should be based.

Includes full-scale evaluations of two important "water crises" and proposals for their solution—the *Cannonsville Project* for New York City, already under construction, and the pending *Feather River Project* in southern California, which, if approved in this November's election, will cost Californians three billion dollars. A RAND Corporation Research Study. Maps, tables, charts. $7.50

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5750 Ellis Avenue, Chicago 37, Illinois
IN CANADA: *The University of Toronto Press, Toronto 5, Ontario*

Field Notes

APPLIED CONSERVATION ON CONNECTICUT HIGHWAYS

The inflexible laws of wind and water erosion impose heavy and inevitable penalties upon the negligent road builder or the recalcitrant road maintainer. A progressive highway program must be planned, among other things, upon the basic principles of sound soil and water conservation. This means employing the use of grasses and legumes, and where grass alone is not sufficient, functional plantings of low shrubs, vines, and trees to reduce run-off and keep the soil in place (2).

In Connecticut, John L. Wright, Engineer of Roadside Development, and his small staff of landscape engineers are responsible for roadside design and the roadside maintenance policy . . . no mean task for a system of over 3,100 miles of state and state-aid roads and over 12,000 acres of roadside area.

Cyanograms Photo

Figure 1. Hydraulic ferti-seeding of slopes as soon as possible after the final grading is the first practical step in erosion control and slope stabilization. This machine can seed and fertilize 65,000 square feet of graded roadside in about 20 minutes. The use of bulk urea, triple superphosphates and muriate of potash has reduced fertilizer handling as much as 50 percent.

Photo by William C. Green

Figure 2. Functional plantings (in this case fragrant sumac) at bridge also serve to prevent children from playing in this hazardous area.

This program, including hydraulic ferti-seeding (1), has reduced the cost of establishing vegetation on roadside acres. One important outgrowth of hydraulic seeding has been the virtual elimination of the use of precious topsoil on the many acres of cut and fill slopes, freeing site-salvaged topsoil for use on median strips and interchanges.

Under the roadside program slopes and median strips are seeded and fertilized as soon as possible during the construction of a new highway (figure 1). Areas subject to probable erosion are mulched immediately after seeding with about 1½ tons of hay per acre which is blown on mechanically. Old established areas are topdressed with nitrogen, or a balanced fertilizer, as often as required to maintain an effective vegetative cover.

Insecticides, fungicides, and herbicides are all employed in the constant battle to protect the health of the invaluable sod, shrub and tree mantle that cloaks the roadside from the very edge of the pavement to the outer limit of the right-of-way.

Blankets of crushed stone or asphalt are placed in the bridge shadow where vegetation is impractical to retard erosion. Around bridge abutments a protective shawl of low, but close growing shrubs are planted to prevent commuter footpaths (which can lead to serious erosion). These functional plantings also serve to blend the harsh bulk of the abutment into the landscape (figure 2). The use of chips from green hardwood has been found effective in discouraging weed growth (and reducing erosion) until the shrubs are established.

It is often necessary to provide shallow drainage-ways along the center of median strips to collect the excess run-off water from the pavement and lead it to catch-basins. Delay in seeding these drainage areas, or a heavy rainfall shortly after seeding, can lead to rampant erosion and clogged catch-basins (figure 3). The use of strips of burlap (8 oz. weight, 60 inch width) placed firmly on the freshly shaped and seeded soil surface (figure 4) is effec-

Figure 3. (below) Rampant erosion can occur in the drainage ways of newly constructed median strips causing the loss of precious topsoil and clogging catch basins.

Figure 4. (right) Burlap carefully placed in the median depression immediately after seeding effectively serves to prevent erosion until the grass is established.

tive in preventing seed and soil movement. A few short weeks later a luxuriant stand of grass growing through the burlap provides a permanent erosion-resistant waterway.

There are many techniques applicable to the job of vegetating highway roadsides. The few described here demonstrate the application of some of the accepted principles of soil management, landscape engineering, and soil conservation used by the department. The fund of available knowledge in these related fields is sufficient to negate most of the apologies for unstabilized highway slopes or erosion on the right-of-way.

The rewarding result of a highway planned, built, and maintained with the principles of conservation diligently observed is a thoroughfare which is safe to travel upon, economical to maintain, and beautiful to behold.

E. F. Button, the author, is agronomist for the Connecticut State Highway Department with headquarters in Portland, Connecticut.

LITERATURE CITED

1. Button, E. F. *Hydraulic ferti-seeding,* Cyanograms, Fall 1958.
2. *Landscape design policy,* Conn. State Highway Dept., Sept. 1955.

STREAMFLOW RECORDS SHOW BENEFIT OF LAND MANAGEMENT

Opinions differ concerning the effects of good forest management and soil conservation on downstream stormflows. To find whether land management had an effect on stormflows from a watershed in eastern Ohio, 20 years' records of precipitation and streamflow were examined. These records indicated better management of farm land and woodlands had helped reduce stormflows, especially near the end of the second decade.[1]

The watershed is the drainage area of Leesville Reservoir, located in the Muskingum Watershed Conservancy District of Ohio. This 30,000-acre watershed contains much hilly, broken terrain.

In general, land use has been steadily improving in the area since the early 1940's. Abandoned hillsides are being reforested or are reverting naturally to hardwood timber. Between 1941 and 1951 the Muskingum District planted 1,200 acres of open land to pine. Today 8,000 acres of the watershed are forested; this is an increase of 3,000 acres since 1940. Furthermore, farming methods are improving; since 1944, the Soil Conservation Service has helped farmers develop farm plans for 40 percent of the watershed (figure 1).

Because interest lay in major stream rises, only those flows resulting from 1 inch or more rainfall in 24 hours, during the period 1938-1958 were considered. For each storm rainfall was related to the resulting stream rise to get the average run-off for a given amount of rainfall. Then the differences between individual and average rises were compared by year and by season to find whether these flows had been reduced, increased, or were unaffected.

A slight downward trend in average run-off had taken place during the period (figure 2). The reductions were more pronounced for rainfall of 1 to 2 inches than for storms of 2 to 3 inches. For storms of greater than 3-inch rainfall, no meaningful change was found in any season.

The only season not showing a reduction was spring (April through June). Extremely heavy rainstorms occurred in June

Figure 1. On many farms erosion has been halted by good soil management.

[1] The author wishes to acknowledge the cooperation of the Muskingum Watershed Conservancy District, the Soil Conservation Service, and the Corps of Engineers, U. S. Army, for the material on which this study is based.

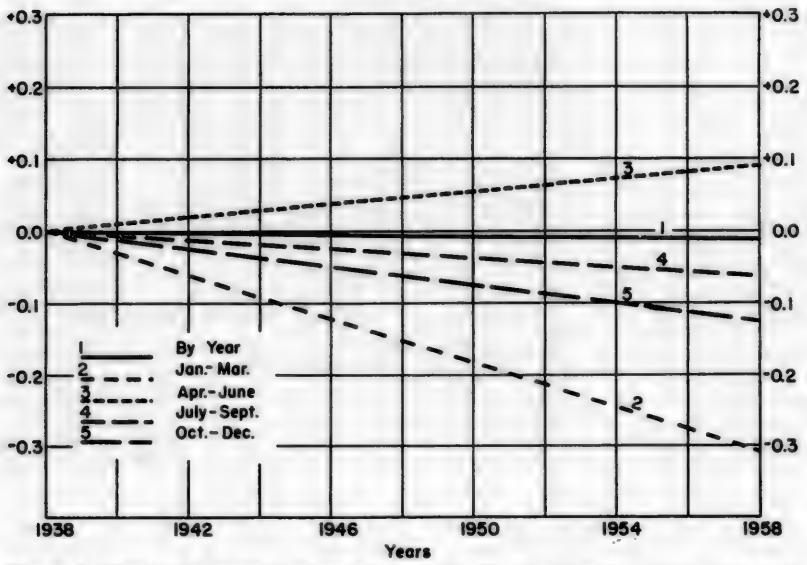

Figure 2. Changes in average stormflows at Leesville Reservoir for storms of 1 inch and greater rainfall for the period 1938-1958. The vertical axis indicates streamflow changes (area-inches).

1947 and April 1948 and an unusual ice storm occurred in April 1957. The high runoff resulting from these storms may have been largely responsible for the upward slope of the trend line for the spring season. During these months rainfall is very erratic, ranging from long, winter frontal storms of low intensity to summer thunderstorms of short duration and high intensity. Soil moisture usually remains high during this period even though some water is being lost through evapotranspiration. As a result most water from frequent intense spring thunderstorms becomes runoff.

Average runoff during the summer months (July through September) shows a slight downward trend. During this period rainfall occurs in high-intensity, short-duration storms, but soil moisture is usually much less than in the spring. More water can be absorbed and stored in the soil at this time, and less becomes streamflow.

The fall and winter seasons show a general decrease in storm runoff, but these seasons usually do not receive heavy, flood-producing precipitation. However, winter flood flows may occur even from well-managed, open areas if the rain falls on frozen ground.

Streamflow is largely affected by soil, geology, climate, topography, land use, and vegetation on the watershed. Only two of these have steadily changed throughout the 20-year period: land use and type of cover. Although half the watershed is still being farmed and logged as it was 20 years ago, the tendency is toward better land use. It is reasonable to assume that this trend will continue until most of the watershed is under some form of soil conservation program. It is also reasonable to assume that as land management continues to improve stormflows will decrease, at least for the smaller storms. The extent of this decrease cannot be predicted, however, and may not be known for another 10 to 20 years.

Ronald Z. Whipkey is research forester at the Athens Forest Research Center.

NATIONAL FARM-CITY WEEK

National Farm-City Week will be celebrated throughout the Nation November 18-24. A wide variety of excellent materials and program aids are available from the offices of the National Farm-City Committee, 101 East Erie Street, Chicago 11.

It is none too early to begin planning a top-notch program for next year. This particular week would provide an excellent occasion, as would any other week during the year, for conservationists to take that "first step" in actively seeking the whole-hearted support, particularly, of the urban population. Community groups are always seeking good programs. What better bridge could one build toward good community relations than by offering one of the literally hundreds of these groups, a tour of conservation projects completed and areas needing attention.

AUDIO-VISUAL AIDS

Film: Agricultural Engineering—Profession With a Future. 16 mm., 14 min., color, cleared for television, 1960. American Society of Agricultural Engineers, Saint Joseph, Missouri, in cooperation with the Motion Picture Service, Office of Information, U. S. Dept. of Agriculture, Washington, D. C.

This film is noncommercial although some commercial products are used in many scenes. A copy of the film is available for loan throughout the Nation at USDA cooperating film libraries, a list of which can be obtained from the Society.

The purpose of the film is to inform young people of the opportunities in agricultural engineering and aid them in planning basic courses of study preparatory to college agricultural engineering training.

Catalog: Motion Pictures of the U. S. Department of Agriculture. Agricultural Handbook Number 14, 1960 edition. U. S. Government Printing Office, Washington, D. C. $0.25.

Film: Growing Alfalfa Successfully. 16mm., 25 min., color. American Potash Institute, 1102 Sixteenth Street, N.W., Washington, D. C. (No rental charge.)

This movie presents the value and uses of alfalfa, its origin and introduction into North America, the soil and nutrient requirements, and stresses the management techniques of fertilization, liming, seeding, inoculation, cutting, weed control, and insect and disease control.

Catalog: A Critical Index of Films and Filmstrips in Conservation. The Conservation Foundation, 30 East 40th Street, New York 16, N. Y. (Free)

Teachers should find this a particularly helpful publication. Each film or filmstrip is briefly described. Part I includes those materials the Audio-Visual Dept. of the Foundation has found useful. Part I consists of selected films that three teachers have found helpful, along with names and addresses of film distributors.

FOUNDATION FORMED

A new Foundation for International Potash Research has been established by six major potash producers of the United States. Headquarters of the new group will be at 1102 16th Street, N. W., Washington, D. C.

The main purpose of the Foundation is to work closely with agricultural authorities of various countries to increase efficiency in crop production, according to Dr. H. B. Mann, president of the new Foundation.

News Notes

PRESIDENT'S COLUMN

The recent annual meeting of the *Society* at Guelph, Ontario, Canada, gave us an opportunity to see more of the vast area of unlimited resources in North America. It opened up new horizons—you might say it pointed up "resources, unlimited." The only limitation is our inability to foresee, envisage, and comprehend so as to correctly plan, harness and utilize existing potentialities for the benefit of mankind.

Like the great untapped resources and possibilities in North and South America, there are unlimited possibilities for us in the *Soil Conservation Society of America* to use our God-given facilities. Existence is given us for action; our worth is determined by the deeds we do rather than the emotions we feel. Working together we can achieve our goals.

A drop of water converted into steam by heat is the lightest and airest of visual substances. Robert J. Fulton will be remembered forever for harnessing the power of steam and making it subservient to the needs of mankind. Our individual contributions to the work of the *Society* are in themselves but drops of water; when united with those of our fellow Society members, they become a power that extends into new horizons.

An early philosopher said, in essence, "There is no progress without change." By this and other tokens, the *Society* has made real progress in 1960. Our thirty committees and our special representatives have notable achievements to their credit. Superior committee reports were presented at the fifteenth annual meting. The outstanding chapter representatives session brought out ways and means of improving chapter activities which will be summarized and relayed to all chapters. We members glow with pride at the acquisition of the approximately five acre rural building site adjacent to Des Moines. Architects' drawings for the new *Society* home are in the developmental stage and the building project will be under way in 1961. Many members are inspired by the enthusiasm and drive of the new JOURNAL editor and assistant executive secretary, Walter E. Jeske. Improvements in the JOURNAL help maintain its position as the top publication in the field of soil and water conservation.

(Continued on page 283)

AGRICULTURAL ENGINEERS MEET

The 1960 meeting of the American Society of Agricultural Engineers was held recently in Columbus, Ohio. *SCSA* members may be interested in writing the authors to secure copies of their papers presented at the convention: "The Effects of Minimum Tillage for Corn and Subsequent Cultivators on Infiltration and Erosion" by L. D. Meyer and Jerry Mannering, Purdue University; "Runoff and Erosion Control on Rangelands" by W. G. Glover, Dept. of the Interior; "Anchoring Vegetative Mulches" by W. S. Chepil, et al., Kansas State University; "Terrace Construction by Cut and Fill Methods" by Paul Jacobson, SCS, Des Moines; "Durability and Stability of Underdrains and Surface Subsidence Due to Drainage in Organic Soils" by W. A. Cutler, et al., Michigan State University; "Nature and Scope of Surface Drainage in Eastern United States and Canada" by Elmer Gain, SCS, Upper Darby, Pa.

A RECORD

"An *SCSA* membership equal to slightly more than 1 percent of the total population of the area!" Sound impossible? It isn't. This is the record for which Roy E. Ballard is responsible in the Tehachapi area of California. During an 8 month period beginning last November he secured over 100 *Society* memberships. Well done!

DATES TO REMEMBER

1960 American Society of Agronomy. December 5-8. Chicago, Illinois.

North American Wildlife and Natural Resources Conference. March 6-8, 1961. Washington, D. C.

National Wildlife Week. March 19-25, 1961. Sponsored by National Wildlife Federation.

National 4-H Club Week. March 4-11. Sponsored by Federal Extension Service, U.S.D.A.

National Association of Soil Conservation Districts Convention. February 5-9, 1961. Memphis, Tennessee.

Ohio Water Management Conference. December 8-9. Columbus, Ohio.

For further information concerning any of these meetings please contact Society headquarters, 838 Fifth Avenue, Des Moines 14, Iowa.

1961 ANNUAL MEETING PROGRAM COMMITTEE

Frank H. Mendell has been named chairman of the 1961 Society Annual Meeting Program Committee. Mendell is State Soil Conservationist in Iowa, with offices at 405 Iowa Building in Des Moines, Iowa.

Also selected for committee membership were Roy D. Hockensmith, John B. Stall, Warren T. Murphy, John Bradshaw, Dr. A. R. Bertrand, Charles A. Dambach, Dr. Cecil H. Wadleigh, Dolph Craig, and N. R. Richards (advisory member).

SCSA members are urged to send any suggestions concerning the annual meeting program to the committee chairman or members immediately for the program is now being formulated.

AGRARIAN REFORM

Pressing problems in the agrarian structure of African countries was the subject of an East and Central African development centre (seminar) on land policy held at Nairobi, Kenya, and Fort Portal, Uganda.

The meeting was held October 3-24 and and was jointly sponsored by the Food and Agriculture Organization and the United Nations Economic Commission for Africa. The centre began in Nairobi on October 3 and after a 4 day series of field trips, including the Kenya government's land consolidation scheme, a series of presentations and discussions was held at Fort Portal.

Dr. E. H. Jacoby, chief of FAO's Land Tenure and Settlement Branch, states: "In many parts of the world, agricultural development to provide for rapidly expanding populations is being hindered by defects of the agrarian structure. At this centre special attention was given (1) land use practices in relation to problems of agrarian structure, (2) the process of individualization of land tenure, (3) tenure arrangements, recording of land rights, land consolidation and administration, agricultural credit, land resettlement, partnership arrangements, marketing and agricultural cooperatives, and (4) participation of local people in the process of rural development related to measures for reform of the agrarian structure."

This is the sixth such centre co-sponsored by FAO. It was the first land policy centre on the African continent and plans are now underway for a similar centre in West Africa in 1962-1963.

Thomas L. Kimball of Denver, Colorado, became executive director of the National Wildlife Federation on September 1. He was previously director of the Colorado Game and Fish Department. Kimball has served twice as president of the Western Association of Game and Fish Commissioners and as president of the Midwest Game and Fish Commissioners.

SOIL SCIENCE CONGRESS

The eighth International Soil Science Congress was held on the campus at the University of Wisconsin August 15-23 under the auspices of the Soil Science Society of America.

Professor Emil Truog was manager of the Congress which attracted over 400 soil scientists from 75 foreign countries (30 from the USSR), as well as a large number from the U. S. Further information concerning the Congress proceedings may be obtained from Professor Truog, Soils Building, University of Wisconsin, Madison 6.

JOURNAL DAMAGED?

Journals are mailed to *Society* members without envelopes. It would probably cost $1,500 to mail them in envelopes. If your copy arrives in poor condition, please write for a replacement.

RECENT COUNCIL DECISIONS

The Council of the *Soil Conservation Society of America* met at Ontario Agricultural College just prior to the 15th annual meeting. All members were present, including those elected to start their service on January 1, 1961.

Many of the actions of the Council were reported in the September JOURNAL or will appear elsewhere in this or succeeding issues. A summary of some important actions follows.

The Council:

1 Noted the death of Dr. H. H. Bennett, founder of the *Society*, and took action to commemorate his work through plans to dedicate the *Society's* new home in his memory.

2 Enlarged the Housing Committee, to work on details of construction plans, to five and appointed Frank H. Mendell of Des Moines, chairman, to replace the late J. S. Russell.

3 Noted the progress of the campaign for funds for the *Society* home and requested the Editor to consider publishing a bi-monthly summary of such funds.

4 Heard a report of a new system of handling and recording manuscripts and bringing up-to-date a calendar for publication of articles submitted to the JOURNAL OF SOIL AND WATER CONSERVATION.

5 Took action to encourage chapters of the *Society* to join in the holding of regional meetings and authorized procedures for handling such meetings. This action was based on a request by members desiring to sponsor a meeting in conjunction with the Southern Association of Agricultural Workers.

6 Approved final plans for a popular type booklet to be known as "Keep Our Land Beautiful."

7 Approved an enlargement of the *Society's* Awards Program to include organizations such as the press, radio, movies, television, industry, corporations, churches, societies, foundations, civic, clubs and others, to receive recognition from the *Society*.

8 Approved editorial changes in the bylaws to include Alaska and Hawaii as states.

9 Listened to a report by the *Society's* Program Development Committee that envisioned growth and development of *Society* programs dealing with scientific and technological aspects of soil and water conservation and related fields.

10 Approved a new format for the 1961 annual meeting allowing sectional subject matter meetings in areas of general membership concern. Theme of the 1961 meeting is to be "Land Use in a Changing Agriculture." The meeting will be at Purdue University, Lafayette, Indiana, July 30, 31, August 1, 2, 1961.

11 Adopted the theme "World Progress With Conservation" for the 1962 annual meeting to be held in Washington, D. C., August 26-29, 1962,

12 Charged the chapter activities committee with responsibility of clarifying, improving, and emphasizing criteria to guide chapters in preparation of chapter activity contest entries.

13 Approved Utah as the location for the 1963 annual meeting and instructed the executive secretary to make additional study.

14 Approved the bid of the Mississippi Chapter to hold the 1964 annual meeting in Jackson.

15 Approved the bid of William Penn and other chapters in the Northeast to hold the 1965 annual meeting in Philadelphia.

16 Appointed N. R. Richards, Canadian Region Council Member, to represent the *Society* on the "Resources For Tomorrow Conference" to be held in Montreal in 1961.

17 Appointed Elmer Smith of Illinois to fill the unexpired term of J. S. Russell on the Development Fund Board. Appointed Firman E. Bear and E. D. Bolton to three year terms on the Board.

"Journey of a Raindrop" was the title of this exhibit at the Boy Scout Jamboree held in July near Colorado Springs, Colorado. The forest officer shown is using an enlargement of the conservation chart to explain effects of land use on the soil and water resources of an area. The Forestry and Range Section at the Jamboree was cooperatively conducted by the U. S. Forest Service, Bureau of Land Management, American National Cattlemen's Association and the American Forest Products Industries. SCSA member Jess W. Smith was chairman of the committee in charge of this section.

(Continued from page 281)

Our *Society* staff is composed of well-trained, eager, sincere workers. The assistance of each member of the *Soil Conservation Society of America,* through local chapters and *SCSA* officers, is the source of the excellent leadership and teamwork which achieves our *Society's* goals.

Since it about time to work out your Christmas list, remember our *Society* home office building project needs a Santa Claus too. With everyone pitching in and assuming his fair share of the obligation, this building can become a reality in 1961.

I welcome this opportunity to thank all *SCSA* members for their splendid spirit of cooperation in 1960. It has been a rewarding and unforgettable experience to serve as your president. It is with real pleasure that I anticipate rejoining your ranks to support 1961 president-elect, Walter C. Gumbel, and his officers in achieving another outstanding year in advancing the objectives of the *Society*.

In closing, I urge active participation by each and every member, individually and especially through chapter activities, to help in raising the necessary funds to construct in 1961 "The Home of the *Soil Conservation Society of America.*" We are a world community in an atomic age and as members we have obligations to work for the common good of the community. The basic importance of soil, water and related renewable natural resources to the material and moral welfare of man makes conservation a "must." The *Society,* through the best efforts of its members in the development and advancement of the science and art of good land and water use, will provide leadership in assuring mankind the use and enjoyment of these basic resources forever.

—ELMER L. SAUER,
President

THE WONDER OF WATER

Dr. Jose Rafael Garcia, Chief, Division of Education, Department of Renewable Natural Resources, Ministry of Agriculture, Caracas, Venezuela, has been granted permision by SCSA to translate into Spanish the popular booklet "The Wonder of Water." The actual translation will be done by Dr. Solorzana at the expense of the Venezuelan government and distribution as well as printing will be done by that government.

Previously the popular *Society* booklet "The Story of Land" was translated into Spanish for use in Puerto Rico and South America.

FIFTEENTH ANNUAL MEETING PAPERS

During the last week in September, mimeographed copies of all papers presented at the *Society's* 15th annual meeting, held on the campus of Ontario Agricultural College, Guelph, Ontario, Canada, were mailed to each registrant.

A large number of comments have been received indicating that the presentations at this meeting were of superior caliber. Additional sets of these papers and copies of individual presentations are now available from the *Society* office. Please note the charges on the order form below.

It would be well for the cause of conservation if these materials could obtain wide distribution. Order a set for a co-worker or friend.

Soil Conservation Society of America
838 Fifth Avenue, Des Moines 14, Iowa

Please send to: I have enclosed $_____

Name _____

Address _____

(Single copies of individual papers, 25c. Complete set of papers, $1.00). I have checked the titles of the papers I desire.

( ) 181. *Ontario's Conservation Authority Program*—A. H. Richardson
( ) 182. *Soil Conservation in a Dynamic Future*—Marion Clawson
( ) 183. *Man, Land and Technology*—Elmer L. Sauer
( ) 184. *Today's Challenge to the Conservationist*—Firman E. Bear
( ) 185. *Canada's Resources*—Hon. Alvin Hamilton
( ) 186. *Land and People*—D. A. Williams
( ) 187. *Air Survey Techniques Advance Land Use Mapping*—D. N. Kendall
( ) 188. *Minimum Tillage, Interseeding and Mulches Aid Conservation Practices in the Upper Mississippi Valley*—Orville E. Hays
( ) 189. *Soil and Water Conservation Research*—Omer J. Kelley
( ) 190. *Forward with Forces in the Forest*—Lowell Besley
( ) 191. *Some Economic Considerations in Land Resource Use and Management*—Carl P. Heisig
( ) 192. *Forage Dynamics in Soil Conservation*—Maurice E. Heath
( ) 193. *The Farmer's Place in Soil Conservation*—Lawrence Kerr
( ) 194. *SCSA in 1960*—H. Wayne Pritchard
( ) Complete set of papers 181-194.

HUGH HAMMOND BENNETT COINS AVAILABLE

A number of the Hugh Hammond Bennett coins, originally given as souvenirs to registrants at the 14th annual *Society* meeting, are available from the *SCSA* office, 838 Fifth Avenue, Des Moines 14, Iowa.

The cost of a plain coin is $1.00. However, orders will still be accepted for a coin imbedded in plastic. A charge of $2.25 is made for a new coin in a plastic cover.

A special plastic case, together with a new coin, and two of the soil conservation commemorative stamps can also be secured from *Society* headquarters for $2.75. This combination makes a very attractive desk piece.

Originally, 1,200 coins were struck and later another 1,000 were cast from the same dies.

Chapters Note: Chapters desiring to order coins for distribution at chapter meetings, may order them in bulk (minimum is 24) for $.50 each.

The Hugh Hammond Bennett coin was struck in honor of the late, world-famous soil conservationist and founder of the SCSA. One side of the coin is a likeness of Dr. Bennett while the reverse side features the emblem of the Soil Conservation Society of America.

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CHAPTER NEWS

East Tennessee Chapter met recently with 55 members and guests in attendance. Dr. John Bailey, East Tennessee State College, reviewed an interesting paper entitled, "Conservation Projects in Tennessee."

After the chapter decided to make a pledge to the national *Society's* building fund, the group voted to raise chapter dues to $2.50 a year.

Joe Spencer, work unit conservationist at Chattanooga, was named as 1961 chapter president and James Hyde, Jr., Chattanooga attorney, was elected secretary-treasurer.

California Chapter plans for their annual meeting to be held January 18, 1961, are shaping up rapidly. The Central Coast section is host this year. Plans include the presentation of technical papers, reports of section activities and a short business meeting. A banquet is planned for the evening. This meeting will be held in conjunction with the meeting of the State Association of Soil Conservation District Directors.

The chapter is actively considering the establishment of a program of scholarships.

Capitol section reports that they are sponsoring an Explorer Scout group, organized specifically to carry on conservation projects. It is believed this is the first such Scout group organized to get conservation work done.

On June 22 the Kern section held an organizational meeting with Roy Ballard being elected as chairman. A subsequent meeting was held on September 28 to consider the subject "Water."

The San Diego section met on August 18. Section members are making themselves available as consultants for "Career Day" discussions in the local schools.

Pony Express Chapter (Kansas) has made a contribution toward erection of the Agricultural Hall of Fame. An interesting meeting was held in September to review the Thompsonville watershed plans.

Manhattan Chapter (Kansas) reports 52 members and guests attended a meeting at Marysville on September 30. Members of the chapter are sponsoring a series of 10 minute monthly radio programs; they have indicated that tapes of these programs may be borrowed.

The following programs remain in this year's series: November 16—"The Role of Women in Soil and Water Conservation." December 21—"Progress on the Oldest Watershed in Kansas." January 18, 1961—"First 100 Years of Conservation in Kansas." February 15, 1961—"A Banker Looks at Conservation."

Hoosier Chapter (Indiana). September 17 was the date of the chapter family picnic at Alexandria. The annual chapter meeting will be held at Purdue University on January 6 with "Bert" Bertrand as program chairman.

Lester Binnie, chairman of the chapter's booklet sales committee, reports a goal of selling over 500,000 copies of the *Society's* popular booklets this year.

West Virginia Chapter. Jackson's Mill was the site of the 15th annual chapter meeting attended by over 100 persons. Justly proud chapter members displayed the recently won N. E. Region total chapter activity contest banner.

A panel discussion of "Strip Mining" opened the traditionally excellent program at 2:30 on a Friday afternoon. After dinner, W. W. Christenson explained the West Virginia timber marketing program, and this was followed by a chapter business session, ably conducted by chapter chairman George Toben, which drew active discussion until nearly midnight.

The Saturday sessions featured the presentation of several outstanding technical papers, including a panel on evaluation of West Virginia's water resources. A highlight of the meeting was a Saturday evening banquet with Don Robey serving as toastmaster and the Rev. Stacy L. Groscup, West Virginia Minister of the Year, delivering an exceptionally brilliant talk. During the banquet E. V. Wickline received the coveted West Virginia chapter "certificate of merit" for outstanding work in conservation. It was evident from the presentation Wickline was not only a superior soil conservationist by a top notch community citizen.

Dr. and Mrs. Gideon S. Dodds conducted the Sunday morning worship services, depicting with slides some everlasting truths. Two additional presentations rounded out the Sunday morning session. John H. Meyers was named as 1961 chapter chairman, W. H. Wayman was elected as vice-president, and hard-working Robin Harvey was again named to the post of secretary-treasurer.

Chapters recently organized include the **Northeastern Colorado Chapter** with Dr. J. R. Johnston as chairman, the **Nevada Chapter,** Sumner Hatch, chairman, and the **Western Puerto Rico Chapter,** Frank A. Gaudier, chairman, and Luis H. Rivera, secretary.

The **Texas Christian University Student Chapter** has been organized. John W. Templer is chapter chairman and Charles G. Roberts is secretary, while Arthur H. Courtade is the faculty sponsor.

A Home for SCSA — Recent Developments

- *The 99 year lease for the 4.6 acre SCSA headquarters building site has been officially signed by the Iowa State Board of Regents and the Society.*
- *A contract to design the home for SCSA on these wooded, gently rolling slopes has been signed with the Dougher, Frevert and Ramsey architectural and engineering firm of Des Moines.*
- *Preliminary building sketches were available to the Council and Housing Committee on Nov. 7.*
- *The Council has named Frank Mendell, Iowa State conservationist, as chairman of the Housing Committee. Committee members now include: Byron Lodwick, Farmers' Mutual Re-insurance Company; Richard Albrecht, editor of Wallaces Farmer magazine; J. A. Sayre, vice-president of Iowa Power and Light Company; and Herb Plambeck, radio station WHO.*

Building Fund Report—November 1, 1960

Chapter	*Chapter Pledge*	*Individual Unpaid Pledges*	*Paid to Date*	*Other Evidence of Support*
Washington, D. C.	$5,000	$2,790	$1,372.17	(2)
South Dakota		35	1,175.25	
Lincoln (*Nebr.*)			124	(1)
Salina (*Kans.*)			39	
Bozeman (*Mont.*)		20	37	
Wiscensin		16	264	(1) (2)
William Penn (*Del. & Pa.*)	400	40	213	
South Carolina		84	191	(1)
North Texas		8	99.50	(1)
Rio Grande (*N. Mex.*)			74.50	
Inland Empire (*Wash. & Idaho*)			128	
Empire State (*N. Y.*)	2,000	24	309	(2)
California		8	1,177.50	(2)
West Virginia	3,000	899	1,109	(2)
Pocomoke (*Md.*)			5	(2)
Keystone (*Pa.*)	1,000	16	55	
So. New England		24	58	(1)
New Jersey	1,250	28	699	(2)
N. E. Oklahoma			42	
El Paso Co. (*Colo.*)	250		30	
Michigan		310	283	(1) (2)
Ark River Bend (*Kans.*)			19	(1)
Hoosier (*Ind.*)			194	(1) (2)
Bluegrass (*Ky.*)		8	40	(2)
Virginia	2,500	60	418	(2)
Korea			20	(1)
Puerto Rico			30	
Florida		268	287	(1)
Utah		40	30	
N. W. Oklahoma			97	
Central Kentucky			5	
Arizona		16	83	
Georgia	5,000	28	243.50	(2)
North Carolina	5,000		304	(1)
Ft. Hays (*Kans.*)			10	
Green River (*Ky.*)			30	
S. W. Nebraska			14	
N. E. Oklahoma		8	22	
Mississippi		56	31	
Olympic View (*Wash.*)			14	
Lake Cumberland (*Ky.*)			5	
Ozark Mt. (*Ark.*)			15	
Custer (*N. Dak.*)			29	
Kentucky Lake (*Ky.*)			20	
Iowa	5,000		1,009.50	(2)
Manhattan (*Kans.*)		90	219	(2)
Ontario (*Canada*)			66	
Central Oklahoma		8	22	
Minnesota		109	184	(2)
S. C. Oklahoma			62	
S. C. Nebraska		8	103	
N. New England	1,480		45	(1)
Egyptian (*Ill.*)			32	
Red River Valley (*N. Dak. & Minn.*)		8	31	
Border (*N. Dak.*)			15	
Pony Express (*Kans.*)			41	
East Texas		73	54	(2)
Northern Illinois	2,600	484	304.70	(2)
Upper Kentucky River			40	(1)
North Alabama		20	12	
South Alabama			141	
Show Me (*Mo.*)			65	
All Ohio			156	(1)
E. C. Oklahoma			65	
Stillwater (*Okla.*)			56	
Idaho			123	(2)
Blue Stem Hills (*Kans.*)		24	29	
Wyoming		24	61	
Oregon		160	65	(1)
Andrew Jackson (*Tenn.*)	470	66	259	(2)
S. E. Oklahoma			14	
Big Hunt (*Okla.*)			13	
West Tennessee		8	87	(2)
Old Line (*Md.*)			361	
East Tennessee		8	54	(1) (2)
High Plains (*Kans.*)		8	42	
S. W. Oklahoma		8	2	
Louisiana			80	
N. E. Nebraska			28	
Heart of Texas		10	562.51	
Bob White (*Kans.*)			20	
Not Credited to a Chapter		80	257	
Total	**$34,950**	**$5,982**	**$14,226.13**	**33**

(1) General Chapter Support.
(2) Chapter Building Fund Committee Organized

NEWS OF MEMBERS

Norman Berg, assistant state conservationist in South Dakota, will move to Washington, D. C., to fill the combined positions of **Glenn Rule,** personnel executive officer to the administrator, SCS, and **Henry D. Abbott,** assistant to the administrator, SCS. Rule and Abbott will retire at the end of the year.

Donald A. Williams, Administrator of the Soil Conservation Service, has spent the past two months in India under the auspices of the International Cooperation Administration. His trip was in response to a specific request from the Indian Ministry of Food and Agriculture for his help in reviewing Indian soil and water conservation programs which will result in his advice to officials for organization and execution of the program in India.

Ferguson

Peterson

Ervin L. Peterson, Assistant Secretary of Agriculture, has resigned this position to become executive director of the Milk Industry Foundation. Succeeding Peterson as Assistant Secretary of Agriculture is **Mr. Clarence M. Ferguson,** who has been Administrator of the Federal Extension Service since 1953. **Mr. Paul V. Kepner,** a native of Indiana and Deputy Administrator of the Extension Service since 1953, has been named to the spot left vacant by Mr. Ferguson's promotion.

T. W. Edminster has been appointed chief of the Eastern Soil and Water Management Research Branch, Soil and Water Conservation Research Division, ARS, USDA.

Kenneth Huddleston has been appointed executive secretary of the Forest Products Research Society. During his career Mr. Huddleston has been director of public relations for the Farm Equipment institute, director of the Pesticides and Application Equipment Manufacturers Association and editor of the "National County Agent and Vo-Ag Teacher" magazine.

M. Ray Parsons, formerly with SCS as an area engineer, is now special assistant for conservation and erosion with the 12th Naval District, headquartered at San Bruno, California.

D. Harper Simms, SCS Information Division director and chairman of *SCSA* Special Publications Committee, has returned from Europe where he served as public relations director for the U. S. exhibit at the Munich International Food Fair, September 21 to October 6. The exhibit was well received and won a Gold Medal at the Fair.

Simms made short stopovers in England, Belgium, Italy, and Spain to confer with conservation officials.

Howard C. Jackson has been named as Missouri State Conservationist for the Soil Conservation Service. Jackson, assistant State conservationist since 1943, will succeed **Oscar C. Bruce,** who is retiring at the end of the year after 26 years of service in USDA.

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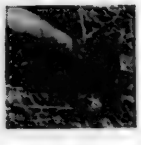
- **Selvage edges and center yarns (where material is stapled to ground) mildew-treated and reinforced for longer life.**
- **Holds mulch snugly in contact with soil through growing season.**
- **Does not have to be removed.**
- ***Economical—costs approximately 4¢ per square yard.***



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SOIL SEALING CHEMICAL

Scooped out of rocky desert land, this 300,000 gallon tank (pond) normally lost 3¼ inches of water every 24 hours.

After treatment with 300 gallons of SS-13, water drop was reduced to ⅞ inches each 24 hour period. Tank now serves 150 head of cattle. It was built in 1920 near Phoenix, Arizona, and until treated with SS-13 was considered useless.

This soil sealing chemical manufactured by SS-13 Sales Company has been applied commercially to approximately 50 tanks in Arizona. The average amount of seepage reduction is approximately 75 percent the company states.

USEFUL BOOKLETS

"Controlled Water Works for You" is the title of a new brochure published by the Caterpillar Tractor Co. This eight page booklet, available by request, points up the relation between water control and lowered damage from floods, adequate stock and irrigation water in time of drought, possibilities for increased agricultural profits and more complete utilization of the recreational potential of water.

Also recently issued by Caterpillar is an 18 page booklet, "Sure Crop Farming."

HIGH MOISTURE GRAIN STORAGE

Just introduced by the A. O. Smith Corp. is a new oxygen-free storage bin for high moisture grain. The structure is 30 feet high and 18 feet in diameter, featuring a new breather system and full length interlocking panel construction.

WATER FROM THE SEA

A technician adjusts dials on sea water conversion apparatus at the Struthers Wells Corp. plant in Warren, Pa. This apparatus is part of a process that freezes sea water to obtain fresh water in the form of ice crystals.

The American industrial complex now uses an estimated 110 billion gallons of water a day and it will need twice that amount by 1980.

Working under a contract awarded by the U. S. Dept. of the Interior's Office of Saline Water, the Struthers firm and the Scientific Design Co. have completed an engineering evaluation of their process in a model plant. The system operates by bubbling refrigerant through sea water under controlled conditions; large pure ice crystals are produced and then washed free of salt in a centrifuge, leaving the ice free of brine.

LAND CLEARING EQUIPMENT

Fifteen different specialized land clearing tools are available from the Felco Corp. for use with Caterpillar track-type tractors. A new six-page folder in English, Spanish, Portugese and French describing these attachments is now available.

IRRIGATION FURROWER

Designed for extending the irrigation furrows through the headlands, a tractor powered furrower is now being manufactured by the J. I. Case Company.

This implement will replace the expensive hand labor required to repair closed or damaged irrigation furrows. It is specifically designed to recut furrows closed by cultivating equipment turning in and out of the headlands. According to the manufacturer it will cut six furrows 5½ inches deep and 13¼ feet long in one minute.

ALUMINUM CULVERTS

A corrugated product called Kaiser Aluminum culvert sheet has recently been introduced by the Kaiser Aluminum and Chemical Corp.

It is priced competitively with galvanized steel. This material is but one-third the weight of its steel counterpart, yet withstands heavy loadings satisfactorily. According to the manufacturer the culvert has been tested in the basic U. S. soil types and found to have superior corrosion resistance.

The new sheet product is made at Kaiser's mills and delivered uncurved to culvert manufacturers. Aluminum allows the use of conventional hand and power saws for trimming at installation sites.

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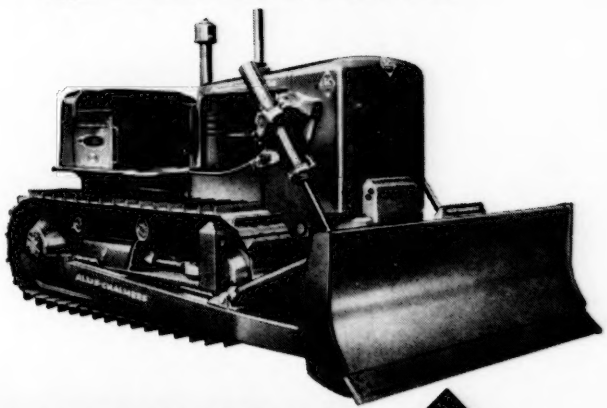

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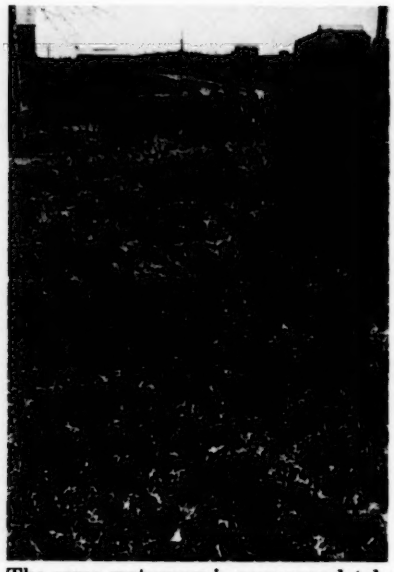

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